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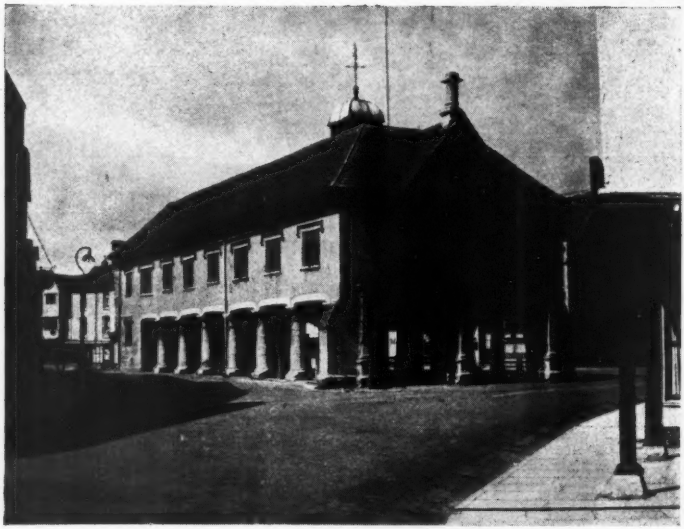

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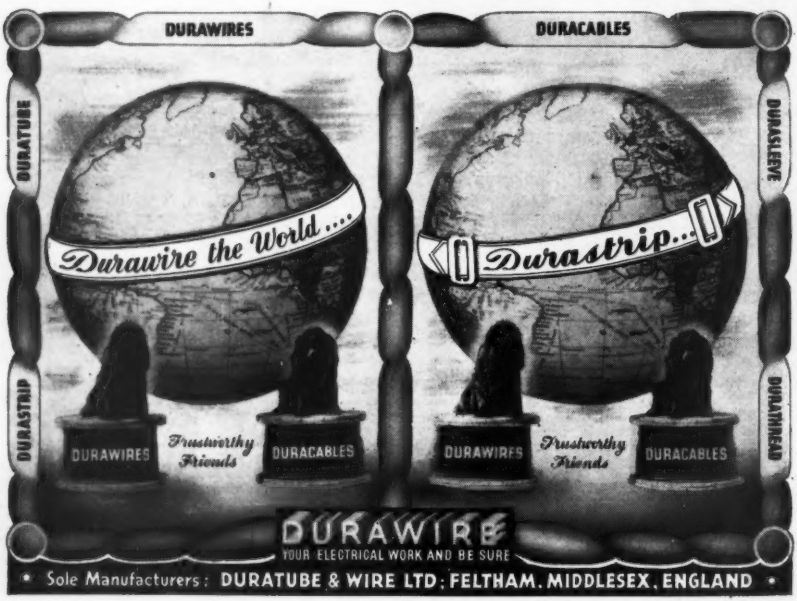

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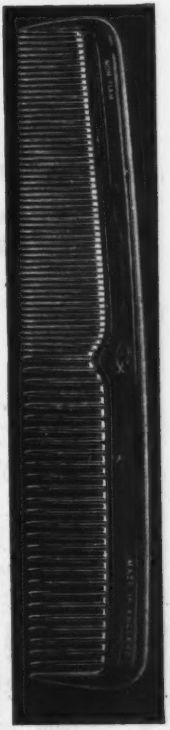

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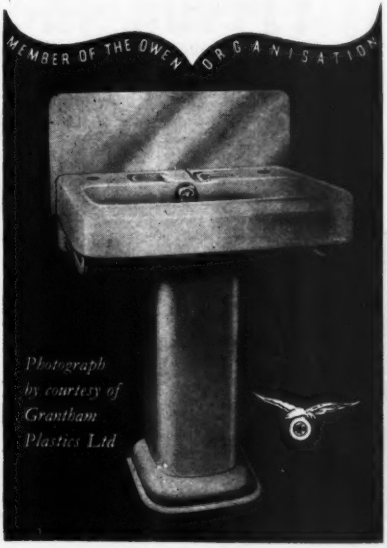

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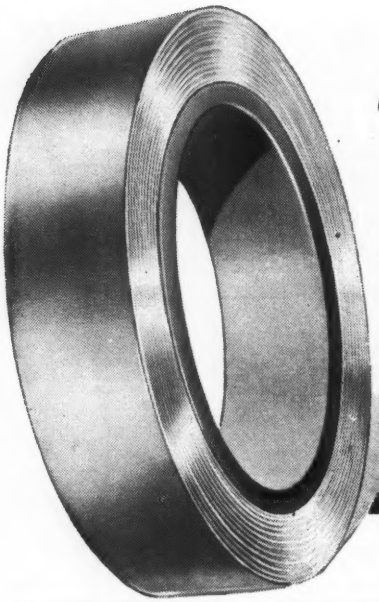

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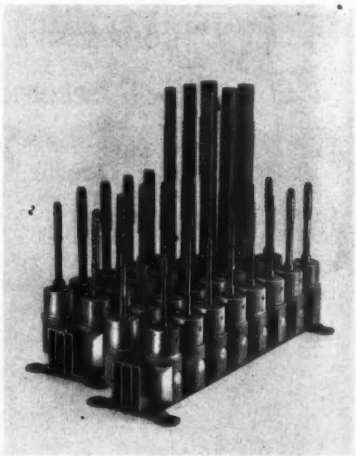

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does not share the views of those "starry-eyed dreamers" of the limitless possibilities of the Industry. Ekco technicians and designers are too sternly practical for that; for having been through the hard school of experience for nearly twenty years, they can tell you just what can and what cannot be done with the Thermosetting and Thermoplastic Moulding processes.

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¶ **The Versatility** of Ekco technicians and the Ekco plant can be seen in the wide variety of Ekco-designed, Ekco-produced mouldings. Whatever the size, intricacy or close limits of the mouldings required, the Ekco organisation will tackle the problem with that same zest with which some people undertake a "Times" cross-word puzzle. The more difficult the problem so much the better; it enables us to give an even more convincing demonstration of our "know-how."

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Point ONE

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Will Plastics do the job? That's the first thing you want to know. Crystalate can tell you and will suggest the Plastic best suited for it at the lowest cost commensurate with the specification, the quality, and the volume of production required.

You require expert co-operation in the initial designing of the piece, and the help given at this vital preliminary stage has won for Crystalate an enviable reputation among the industries which Plastic mouldings serve.

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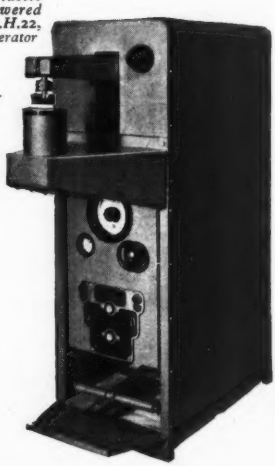
Redifon plastic welder powered by Model R.H.22, 300-watt generator



New automatic plastic welder

THE new Redifon plastic welder is simple to operate, economic in use, and welds all types of sheet plastic perfectly.

Powered by the Redifon Model R.H.22, 300-watt generator, the welder can be set by means of the automatic timer to weld the particular material used in production. An unskilled operator can use the machine easily. As soon as the material is placed in position, the operator presses a foot-pedal, the upper electrode descends, the current is switched on and a signal light illuminated. When the weld is complete the signal light goes off and the operator releases the foot-pedal.

Full details of this Redifon Heating machine and other similar applications of Redifon Heating in the plastics industry can be obtained from our Industrial Electronics Sales Division.

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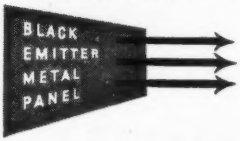
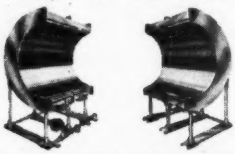


USE IT IN A UNIT LIKE THIS . . .



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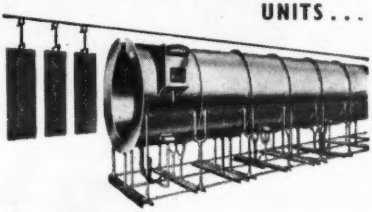

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FINANCE FOR NEW DEVELOPMENTS

Mr. B. C. Westall on Expansion Plans

An extraordinary general meeting of Thomas De La Rue & Co., Ltd., was held on 5th February, in London.

Mr. B. C. Westall, C.B.E. (the Chairman), in the course of his speech said :

The primary purpose of this Extraordinary General Meeting is to implement the promise I made in September to split the present £1 shares and also to make arrangements for the raising of new capital. As I forecast at the Annual General Meeting this splitting will take the form of converting the shares into stock, which will be transferable in 5s. units. We hope that the smaller unit will be a convenience to shareholders and in particular to the small investor.

The Board have decided that it is desirable to raise half a million Pounds in Preference Shares and to issue 116,000 Ordinary shares at a price which still remains to be determined. This, subject to the consent of the Capital Issues Committee being obtained, will provide approximately one and a half million Pounds. It is our intention that our existing shareholders shall be given the first opportunity of taking up all these new shares.

The figure mentioned does not represent the whole of the Company's requirements. Altogether we shall need something approaching a million Pounds over and above this amount. Negotiations have been taking place between your Directors and certain financial interests for the sale of the Plastic Moulding Section, that is to say, De La Rue Plastics, Limited. These negotiations have reached an advanced stage and, subject to the approval of the Capital Issues Committee of the plan for financing the operation, I think we may take the matter as concluded. This transaction, together with the new capital, will provide the additional capital needed for the expansion of De La Rue Insulation, Limited, and De La Rue Gas Development, Limited.

BOLD EXPANSION PLAN

During the past fifteen years the considerable expansion that has taken place in the De La Rue organisation has been carried out almost wholly out of its own resources. This process is no longer possible nor, indeed, desirable. In preparing our plans, therefore, we took the view that whatever difficulties the post-war years might bring, our scheme of expansion should be bold and not tentative, that it should be sweeping and not piecemeal. The first stage was accomplished early in the war by transferring to subsidiary companies certain branches of the old company's business. This operation was essential for the proper development of the various activities in which we had decided to engage. The next thing that we had to do was to decide which of our various activities offered the best field for expansion and development.

After a thorough review of the situation we arrived at the conclusion that the Laminated Section of our Plastics business and the manufacture of gas appliances held out the best prospects for speedy expansion. Some time before the war we had developed at Walthamstow a process of manufacture of laminated boards for electrical purposes, and by the end of 1939 we were producing this material on a small scale. Furthermore, our Research Department had been studying the manufacture of laminated decorative board for constructional purposes. This type of material was being manufactured by the Formica Corporation of Cincinnati, U.S.A., and by Metropolitan Vickers, under the Trade term of Traffolyte. We decided then that this was a suitable field for our activities.

A new subsidiary company was formed, called De La Rue Insulation, Limited, and Mr. J. Eerdmans was appointed its Managing Director. To this Company was transferred the Laminated Section, while the moulding business continued to be carried on by De La Rue Plastics, Limited. During the war a site was purchased at Tynemouth, and immediately on the termination of hostilities a factory was built there to house various departments of manufacture which had been selected. At the time these decisions were arrived at we felt that the building up of the business of manufacturing decorative boards under our own steam, as it were, would be a slow process, and consequently negotiations were opened up with Metropolitan Vickers on the one hand and the Formica Corporation on the other. As a result we purchased the Traffolyte undertaking from the former, and from the latter we acquired the manufacturing rights of the Formica products for the British Empire and certain other territories.

EXTRUDED PLASTICS

Two other forms of plastics manufacture were also planned to be included in the Insulation company. In 1945 an arrangement was arrived at with Extruded Plastics Inc., of Norwalk, Connecticut, whereby we acquired the use of their patents and processes for the manufacture of extruded plastics. A new company was formed, called De La Rue Extrusions, Limited, of which De La Rue Insulation, Limited, holds an 80% interest, the remaining 20% being held by Extruded Plastics Inc. De La Rue Insulation also acquired the share capital of Reinforced Plastics, Limited, a company which held licences for the manufacture of laminated material reinforced to give an extremely strong sheet for certain specialized purposes, as, for example, the covering of railway goods wagons. In addition to the foregoing the Insulation Company has an established business for the manufacture of insulated wires, under the Trade names of HAMOFIL and HAMOLAC, and of tubular sleevings under the Trade name of DELAFLEX.

ENTRY INTO GAS INDUSTRY

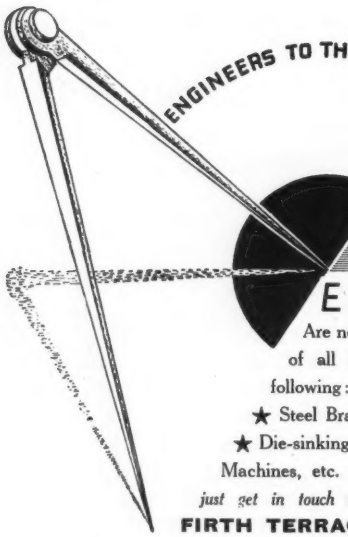
Our second plan for expansion was in connection with gas appliances. Before entering into this new field of industry we made an exhaustive examination of the potentialities of gas water-heaters. We found that there was an excellent opportunity for modern efficient water-heaters, so in order to enter this field we took two steps. The first was to purchase all the shares of Thomas Potterton (Heating Engineers), Limited, and the second was to create De La Rue Gas Development, Limited, all the shares of which are owned by the Parent Company. Thomas Potterton is an old-established business with an excellent reputation for the making of gas-heated boilers, and provided a convenient entry into the world of gas. We have also purchased the assets of Perfecta Gas Appliances, Limited, which specialized in producing thermostat apparatus. Another development that we have introduced is the production of infra-red ray panels for drying and heating purposes.

Altogether the present capital requirements for De La Rue Gas Development, Limited, amount to approximately a million pounds.

Together with the De La Rue Insulation, Limited, and the capital required by the Parent Company for the re-equipment of our Far Eastern factories, our present programme calls for not far short of two and a half million Pounds.

In these days of shortage of materials and labour it would be unwise to prophesy. In my opinion these difficulties will diminish and will in time be altogether overcome. Making allowances, however, for such shortages and difficulties, I expect that in our next financial year, that is to say, the year commencing the beginning of next April, both De La Rue Insulation and De La Rue Gas Development will contribute substantially towards the profits of the Company, and I am convinced will ultimately become valuable properties.

Resolutions embodying the Board's proposals were unanimously carried, and the proceedings terminated with a vote of thanks to the chairman, directors and staff.



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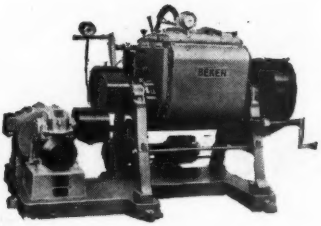

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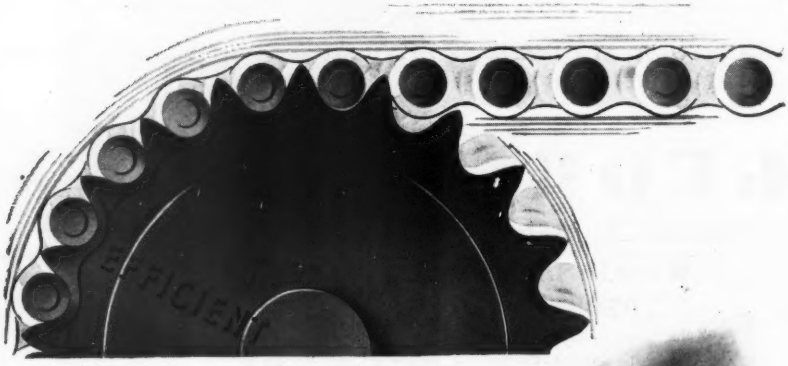

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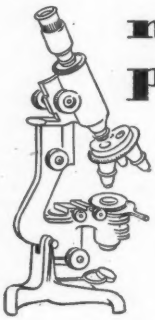

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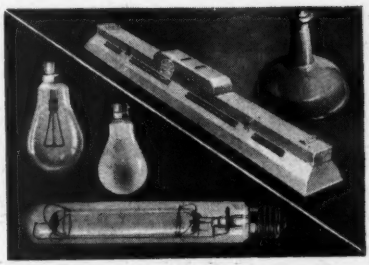

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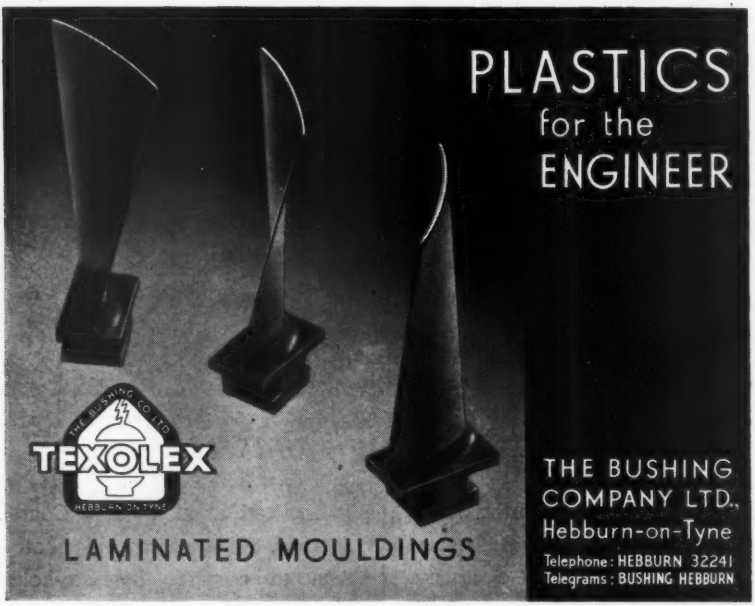

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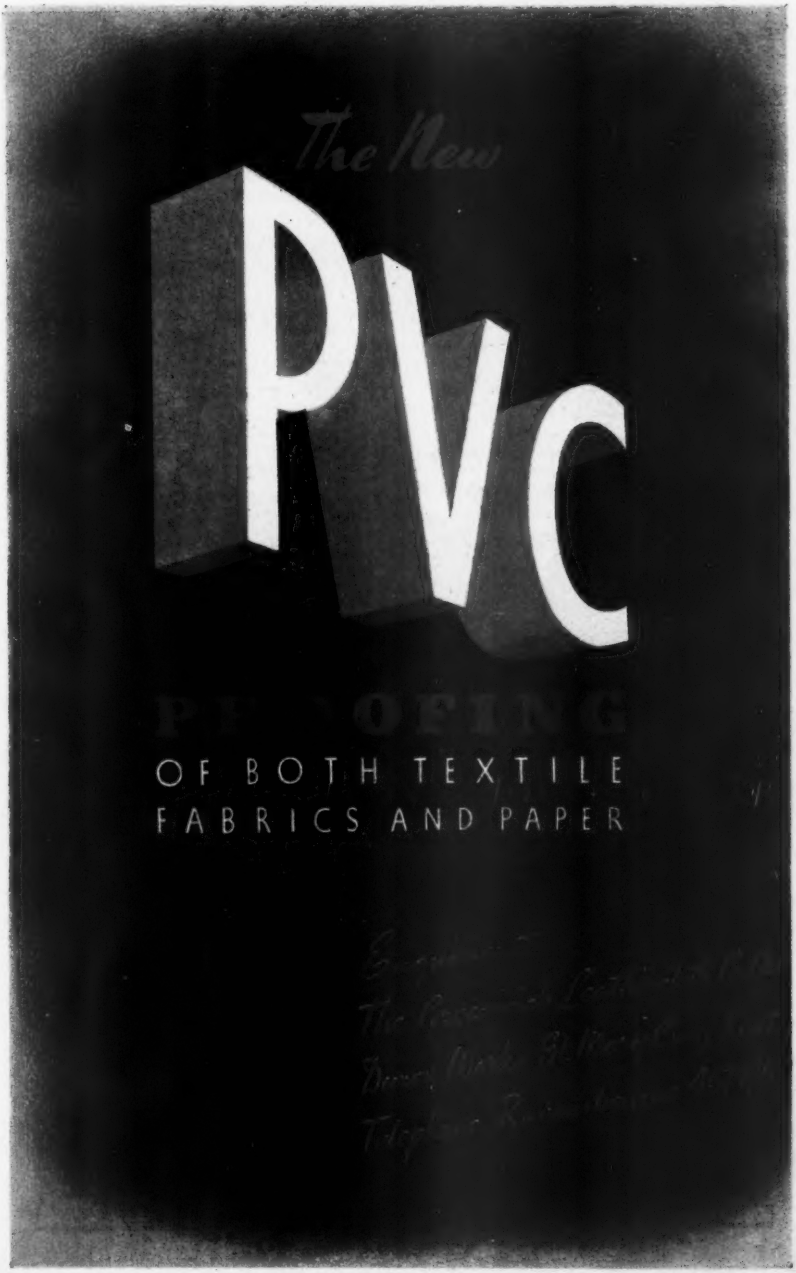
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Vol. XI. No. 118. MARCH, 1947

Plastics

Dealing with the Manufacture, Uses and Potentialities of Plastic Materials

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EDITORIALS

Plastics as Living Materials

ON February 25 we attended a meeting of the Institute of the Plastics Industry to hear G. H. Friese-Greene talk to us on the subject of "Plastics as Living Materials."

Mr. Friese-Greene is a craftsman and managing director of Starkie-Gardner, Ltd., of Wandsworth, London, whose members have been craftsmen for nearly two centuries. When we first met him, he and his workers, some 300 of them, were producing lovely wrought-iron gates, bronze panellings and decorative steel structures. Later, we found him erecting in Harrods stores the beautifully coloured anodized-aluminium escalator with its plastic treads that everybody has admired so much. During the war he was casting bronze submarine screws and making his acquaintance with methyl-methacrylate sheeting, and even then, in our opinion, was surpassing any work on it that we had seen. We have already published some of his work, such as the set of chess for Mr. C. Beatty, his "seal and ball" at the Selfridge Aluminium Exhibition and other work at the "Britain Can Make It" Exhibition. At the Institute of Plastics meeting he went further with his exhibits of carved statuettes, large engraved plaques, ink-stands, plates and "wine-glasses," fruit bowls, etc., of "Perspex" and "Perspex"-silver combinations. Brilliantly conceived and lovely in form, they stand as exquisite examples of the craftsman's art.

We earnestly hope that many fabricators and other workers in "Perspex," against some of whom we have rated for poverty in design and poverty in workmanship, were present to examine his work. Those of them who produced astrodomes for aircraft during the war and in peace-time conceived the brilliant idea of turning them upside down and selling them as fruit bowls to a fascinated public for three guineas a time, or by cutting a piece of transparent plastic square and sticking four or five curved strips of the same material on to the square with a little chloroform or glacial acetic acid and so made a cute little toast-rack, would have learned much.

Mr. Friese-Greene's talk was on the absolute necessity of introducing the craftsman and craftsmanship into the plastics industry. Like those who, by working on metal and stone and wood, have come to know these materials and have fashioned lovely and structurally sound objects, the craftsman will get to know plastics also, will reproduce new forms, discover new physical characteristics and effects of æsthetic merit, and perhaps new methods of fabrication.

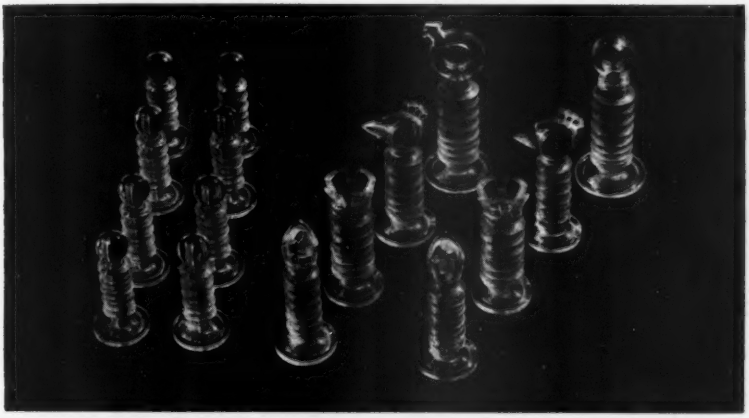
Another urgent plea by the speaker, and again it was a plea for the craftsman, was the necessity for combining plastics with other more traditional material to get a desired result, and to bring out new beauty by perfect marriage of materials of apparently diametrically opposite qualities and properties. His structures of silver and "Perspex," and of aluminium and "Perspex," showed how this could be done.

How much we agree with this! And how long have urged its necessity in these pages, not only from an artistic point of view, but also because of engineering requirements. There are still too many in our industry who believe that plastics must always stand alone.

Obviously, Mr. Friese-Greene's work has been confined in the main to sheet plastics, which includes laminated material. Manipulation of them for such work as he showed, and for furniture and other structures, grows apace, so that there is ample justification for an urgent examination of his case. He has proved

its value in a very economic manner in his own factory.

When we turn to that greater section of the industry, the pressure moulding of a powder to create an object, the necessity for the incorporation of the craftsman into the team is not so obvious, but we are sure Mr. Friese-Greene would desire such a move, especially since he advocates so strongly the formation of modelling shops in industry wherever possible. Many of us consider, and so would he, that we already possess craftsmen in pattern makers and mould makers. Perhaps it is the industrial designer, many of whom merely reproduce designs on paper without "knowing" plastics, who should become craftsmen too, and should "know" and "feel" not merely how plastics behave in the sheet, but also how they flow and behave in the mould itself.



Examples of Mr. Friese-Greene's work. Above, chess set, and below, a panel to announce the famous film "Caesar and Cleopatra." The surround and figures are of aluminium with a "Perspex" background engraved with a typical scene on the Nile.

It would be impertinence to say that Mr. Friese-Greene will go far, for, in our opinion, he has achieved more in his sphere than any other worker in the world. He already points a way in which this country can continue its traditional excellence of workmanship, equal in every respect to the productions of the great workshops of Britain's heyday. He surely carries on the torch of the great craftsmen of the past.

Note.—Those who were unable to see his work may shortly see one of his structures worthy of note on King's Cross Station. It is a large train indicator, fabricated from "Perspex," and the phenolic materials "Holoplast" and "Traffolyte."

Take Care of Your Legs

THIS is no advertisement for the cure of gout, nor is it an appeal to Hollywood aspirants to correct inward or outward curves and to attain parallelism. Instead, we shall talk of those wooden structures, which, although unmentionable and always decorously covered by the more bourgeois of our Victorian forebears, we now unashamedly label with our newly found freedom,—"legs, furniture for the use of."

In one of London's famous cafés near the Marble Arch, you will see (presuming always that you visit these palatial caravanserai so reminiscent of the Taj Mahal or of the President's palace at Xochimilco) that all the wooden legs are covered, if not with nylons, at least with a plastic sheath to protect them—not so much against the cold as against the kicks of the brutal British public.

In truth, the kicks of a thirsty Briton in search of tea and margarined toast, against fate and furniture alike, is a thing to marvel at, and to curse at by any self-respecting restaurateur. The number of table and chair legs that have been thus ruined and destroyed is enough to bring the aforesaid self-respecting restaurateur rapidly before Authority in Carey Street and thence to an early grave.

In the covering of these legs, therefore, we see the employment of plastics at their best—for both utilitarian and humanitarian ideals; and we are assured that not only is protection proven and complete, but that the number of cases of felo-de-se amongst restaurant owners has diminished greatly.

From a technical as opposed to the philosophical viewpoint just described, the reader will be interested too in the manner in which the covering is applied. The plastic is p.v.c. in the form of an extruded tube of circular cross-section (we understand this is supplied by BX Plastics, Ltd.). Its internal diameter is rather less than the "diameter" of each octagonal leg so that complete coverage is a matter of considerable ingenuity. This is attained by urging half an inch of the tube on to the end of the leg and then applying considerable air pressure by means of a compressor. The operation proceeds in stages, jerks or bumps until finally a bicycle lever is brought into play for the last lap.

We are anxiously awaiting confirmation that the process can be applied also to our own furniture with the Cromwellian twist and the Georgian bandy-leggedness.

Thanks Australia!

WE wish to express our gratitude to the Editorial Committee of the Sydney Technical College Chemical Society for reproducing, in the January, 1947, issue of its Bulletin, our editorial on "British Coal and the Plastics Industry," published in the July, 1946, issue of this journal. In this we advocated cutting coal exports to a minimum and using it ourselves to transform into more valuable chemicals which we could then export.

The editor of the Bulletin reminds us that Herbert Morrison said, on December 1, 1946: "If we exported 30,000,000 tons of coal to Europe . . . Europe would give us as great a welcome as on D-day." After criticizing this short-sightedness, the editor advocates the placing of technically trained men in very high places, and adds: "Until that is done we will all be witness to the dissipation of one of the British Empire's greatest natural assets—coal."

Modern Applications of Plastic Optical Materials

Many exaggerated claims have been made for plastic optical materials, and it was inevitable that some disappointment should follow. It is, however, quite wrong to regard these materials as substitutes for optical glass. They should be judged on their merits and be considered as materials which do allow new optical effects to be obtained and thus increase the scope of optical design.

That plastic optical materials have their place alongside the finest optical glass produced, and can be fabricated into high accuracy optical components, was recently demonstrated by Dr. David Starkie, of the Plastics Division of Imperial Chemical Industries, Ltd. The following has been compiled from notes received from his company.

OPTICAL quality polymethyl methacrylate and polystyrene are sold as sheets and blocks in this country as "Transpex" 1 and "Transpex" 2 respectively. Sheets measuring up to 4 ft. by 3 ft. are produced with thicknesses up to 3 ins. In America, polycyclohexyl methacrylate is used in place of polymethyl methacrylate by one important manufacturer of plastic optical components, for reasons connected only with their particular method of fabricating components.

Considerable research has been carried out on the manufacture of "Transpex" 1 and 2 during the past six years. It soon became evident that both materials could be made more suitable for optical uses by preparing them with a higher degree of purity than that usually associated with the normal commercial product. The development of high-purity materials together with new methods of manufacture and treatment of the sheets and blocks resulted in an increase in softening point, a substantial increase in craze resistance, the elimination of strain, and improvement in optical homogeneity.

Table 1.—Optical Properties of "Transpex" 1 and 2

Property	"Transpex" 1	"Transpex" 2
Refractive Index (n_D^{20}) ..	1.4900	1.5900
Relative Dispersion $\frac{(n_D-1)}{(n_F-n_C)}$ ..	57.5	31.0
Reduction in intensity of beam of visible light passing through sheet 1/8" thick..	8%	10%
Exposure to sunlight.. ..	No effect	Very slight yellowing on prolonged exposure

Optical Properties

Table 1 gives the optical properties of "Transpex" 1 and 2. It will be noticed that the two materials correspond to normal crown and flint glasses respectively. Light transmission values in the visible region are high, the limit of transmission in the ultra-violet region is at a lower wavelength than for glass, being close to 2,900Å, and they have high transmission value for photographic infra-red rays. "Transpex" 1 is unaffected by continuous exposure to sunlight, but a minute change in colour has been reported for "Transpex" 2 after several years' exposure.

Table 2.—Physical Properties of "Transpex" 1 and 2

Property	"Transpex" 1	"Transpex" 2
Density at 20 °C ..	1.189	1.053
Tensile strength at 20°C (lbs./sq. in.)	10,000–11,000	5,000–6,000
Impact strength at 20°C (ft.-lb.) to BSS 488 ..	0.20–0.25	0.15–0.20
Cross-breaking strength at 20°C (lbs./sq. in.) ..	16,000–17,000	10,000–12,000
Young's Modulus in Bend at 20°C (lbs./sq. in.) ..	480,000–520,000	450,000–500,000
Scratch Hardness (2 kg. load)	31.0	26.0
Softening Temperature (Vicat Needle Test) ..	120°C	120°C
Coefficient of Linear Expansion..	80 x 10⁻⁶/°C	86 x 10⁻⁶/°C
Thermal Conductivity (c.g.s. units)	3.5 x 10⁻⁴	2.0 x 10⁻⁴

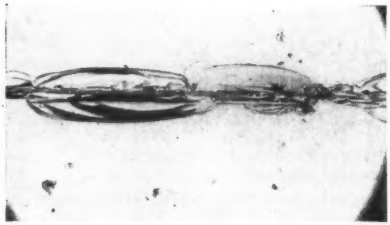


Fig. 1.—Photomicrograph of diamond scratch on glass.

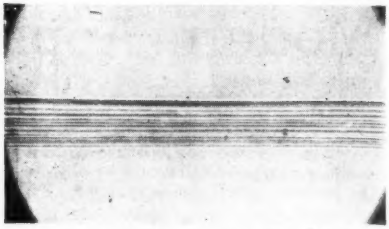


Fig. 2.—Photomicrograph of diamond scratch on "Transpex."

"Transpex" 1 and 2 are pure chemical substances, and their refractive indices are unaffected by slight changes in the method of manufacture. Therefore it is easy to maintain the refractive index accurate to 0.0001 from batch to batch, a factor which is of importance in manufacture of high-quality optical components.

Physical Properties

From the physical properties listed in Table 2 it will be seen that the low density of plastic optical materials (when compared with that of glass) is attractive. Their substitution for glass in an optical instrument, and particularly one containing massive prisms, can result in a considerable saving in weight.

Impact strength is high compared with that of glass, and optical components made from the plastic materials can withstand severe mechanical and thermal shocks. Tensile strength is adequate, but, with a lower modulus of elasticity than for glass, care in mounting is needed, and a careful selection of thickness should be used, particularly when the components are to be used at elevated temperatures.

The scratch resistance of "Transpex" 1 and 2 is low compared with that of glass, although higher than that of "Perspex" and polystyrene as sold for general commercial purposes. The scratch resistance value, as determined by the standard methods of test, is very close to that of aluminium, and it is unnecessary to take elaborate precautions in cleaning the surfaces of components made from them. But although the scratch resistance is low compared with that of glass, it should be pointed out that scratches on the surface of glass have a more serious effect than is the case with "Transpex" 1 and 2. Fig. 1 shows that the edges of a scratch on glass are broken and the light-scattering area extends well beyond the boundaries of the scratch, whereas a scratch on "Transpex" 1 (Fig. 2) is simply a depression in the surface and the light scattering is confined to the actual area of the scratch.

Considerable amount of work is being done on the surface hardening of plastic optical components, and sample lenses have been produced which require no greater precautions during cleaning than would be given to optical glass lenses.

It appears to be the general impression that the use of plastic optical components is limited to temperatures not very much higher than room temperature. Softening points, as determined by a Vicat needle test, is 120 degrees C. for both "Transpex" 1 and 2. However, the maximum temperature at which optical components made from the materials can be used indefinitely without showing distortion is of particular interest. This distortion temperature is a function of the method of fabricating the component as well as the material itself, and if a large amount of strain is introduced during fabrication distortion will take place at a relatively low temperature. A new method of making optical components from "Transpex" 1 and 2, to be described, obviates any trace of strain;

components made by this process have been held at boiling water temperature without showing any measurable change in form.

General Properties

An attractive feature of "Transpex" 1 and 2 is the ease with which they can be sawn, turned and drilled, using normal workshop equipment. The finished component can be milled to special shape, or its edge can be turned to give a special supporting rim. The most convenient method of holding the component during machining is by means of a vacuum chuck, the face of the chuck being made of the same material as the optical component to avoid scratching when any sliding adjustment is required.

The fact that there are only two established optical plastics at present available in this country may appear to impose some limitations in design, but a method of manufacturing components with accurate aspheric surfaces has been devised so that the limitations are not so severe as might appear at first sight. However, many entirely new transparent plastics are being developed in the various research laboratories, and some of these have interesting optical properties. Plastics with refractive indices as low as 1.38 and as high as 1.72 have already been prepared as laboratory samples.

Grinding and Polishing

Many people have attempted to make optical components from "Transpex" 1 and 2 by normal glass-working methods. Some have not been successful, but I.C.I. have reached the conclusion that perfectly satisfactory components can be made in rather less working time than would be required to make a similar component in glass.

The "roughing" of the surfaces can be carried out on a lathe, using a shaping tool. In working the surface, it should be remembered that the material is relatively soft and has high thermal expansion and low thermal conductivity. It is therefore necessary to use low spindle speeds during smoothing and polishing. The various grades of smoothing emery are used during smoothing, and rouge or rouge substitutes during polishing.

Since the optical materials are more prone to surface scratching than glass, it is essential not to replenish the abrasive or polishing compound when the final stages of the smoothing or polishing are reached, but to continue with the powders in which the particle size has been broken down during working. Polishing is done on pitch laps, and the hardness of the pitch is critical; this hardness can only be gauged by experience.

At present, two methods of manufacturing plastic optical components are being used, both based on reproduction from a mould. Provided that the necessary accuracy can be obtained, reproduction from a mould is extremely attractive. It allows components to be made rapidly, and hence cheaply, once the moulds have been prepared; it allows special mounting edges to be provided without additional cost; it reduces the enormous price difference existing in the case of glass between small and large diameter components; and it allows relatively cheap aspheric components to be made.

With aspheric surfaces, systems of great light-gathering power can be designed; indeed, all optical instruments would benefit to a greater or less degree by the substitution of aspheric for spherical surfaces. Further, some optical applications are impossible without aspheric components; in others, a relatively simple aspheric system could replace a much more complicated spherical system and yet give great improvement in performance.

The method of manufacture which has been used in this country for some years is the straight compression moulding of the component from "Transpex" 1 or 2 between optically worked stainless steel moulds. In the early development of the process the optical components were moulded from heated flat sheet. The movement of material during moulding was very big, and, in consequence, the moulding component was full of strain and showed distortion if used at temperatures in excess of 50 degrees C.

In an attempt to reduce the amount of strain present, the process has been modified and the optical components are now moulded from preforms which have been shaped on a lathe. The preforms are buffed after turning, and they fit quite closely to the mould. They are heated up to 110 degrees C., introduced into the steam-heated mould, the mould closed, and a pressure of the order of 2-3 tons/sq. in. applied, and the pressure maintained for a period up to five minutes before the steam through the mould is replaced by cooling water and the component removed from the mould at 50 degrees C. Distortion temperature has been increased by this alteration.

In the American method of manufacturing plastic optical components, the mould is filled with the liquid which, by using a heat catalyst, is polymerized to give a solid reproduction of the interior of the mould. The difficulty is, of course, to control the contraction on polymerization to the required optical accuracy. The contraction is taken up by allowing the two halves of the mould to move towards each other as polymerization proceeds, and ingenious ways of doing this have been devised.

It is possible to carry out a partial polymerization of the monomer, when the latter changes from a thin mobile liquid to a thick viscous "syrup." In this way, part of the contraction can be made to take place outside the mould, and advantage is taken of this to reduce the overall contraction on polymerization in the mould. In order to reduce the contraction still further, one American firm uses polycyclohexyl methacrylate as the "crown" component, since this has a smaller contraction on polymerization than polymethyl methacrylate.

"Surface Finishing" Method

The idea underlying the "surface-finishing" process developed by I.C.I was simple. It was to make a strain-free preform of "Transpex" 1 or 2 as accurately as possible in an optically worked mould, and then build up on the surface of this preform a thin skin of the same material until its surfaces made accurate contact with the mould. Various methods of preparing preforms were investigated, and the one finally adopted is closely similar to that used in the American method of manufacturing plastic optical components, i.e., by straight polymerization in a mould.

For various reasons, particularly with the idea of allowing the process to be operated easily on a manufacturing scale, polymerization by light was adopted in preference to polymerization by heat. Considerable investigation has been concerned with the finding of suitable catalysts and satisfactory conditions.

To reduce contraction on polymeriza tion, partially polymerized monomer is poured into the mould, and the contraction during the final polymerization is taken up by allowing the two halves of the mould to be drawn together in exactly the same way as in the method of manufacturing "Perspex" sheet which has been in operation for a number of years. The preform which comes from the mould is surrounded by "flash," and this is machined off by holding the preform in a vacuum chuck in a lathe after careful optical centring.

Before proceeding to the next stage of the process, the preform is annealed to remove any trace of strain which may be present and which may be introduced by reason of the casting being firmly attached to the surfaces of the mould during polymerization. Annealing is achieved by holding the preform in a liquid bath at 110 degrees C. for two hours, followed by slow and carefully controlled cooling to room temperature.

If the preform is now placed back in the mould, it will be found to depart very slightly from the form of the interior of the mould. To fill up these minute spaces, a film of polymer is cast on the surface of the preform, this film being so thin that its contraction on polymerization can be very accurately controlled. Great skill is required in carrying out this part of the process.

If optical mirrors are being made, a reflecting layer of aluminium is de-

posited on them by evaporation in a vacuum chamber and lenses can be "bloomed," using the same apparatus.

The most attractive feature about a method of highly accurate reproduction from a mould is that it allows optical components with aspheric surfaces to be made rapidly and cheaply once the mould has been prepared, and it is for this reason that the "surface-finishing" process should prove to be of great value in applied optics.

Many attempts have been made to construct machines which would generate aspheric surfaces, but, due to inaccuracies, however minute, in bearings and links, none of these machines has been entirely satisfactory. During the past four years, I.C.I. research workers have concentrated on devising methods for working accurate aspheric moulds. They have preferred to machine the curves to templates, cut as accurately as possible, and rely on hand finishing, using flexible laps to obtain the required degree of accuracy. They have also provided the skilled optical worker with new and accurate tests which enable him to follow the progress of his work, one such test giving an actual picture of the contour of the mould accurate to 0.0001 in. during the early stages of working.

The moulds used in the new process are made of glass, because (a) it is the hardest material available in bulk supply and hence scratching risks are reduced, (b) part of the reproduction process is by light polymerization and hence transparent moulds are required, and (c) methods of optical grinding and polishing glass are well known and present no special difficulties.

The time required to make an optical component by the "surface-finishing" process is quite long, although the actual handling time by the operators is very short indeed. The obvious way to keep the selling price low is to use a large number of moulds and allow them to travel through the various stages of the process on a mechanical conveyor. A factory operated along these lines is in course of construction and hopes to start manufacture towards the end of this year.

There are a number of large-scale applications for which aspheric optical components are essential, and others where the substitution of aspheric for spherical surfaces will give a very appreciable improvement in performance. An example of such applications and one on which, in view of its urgency, I.C.I. have concentrated up to the present, is television projection.

Significance of New Process

It is generally agreed that the television picture on the curved end of the cathode-ray tube which is provided by the present home receiver is unsatisfactory, and that a much larger, flat picture is desirable for easy viewing. The size of the picture can be increased either by providing a much larger cathode-ray tube and viewing the picture directly on the end of it, or by projecting an enlarged picture from a small tube on to a separate screen by means of an optical system.

Unfortunately, there is a limit to the brightness of the cathode-ray tube picture which can be obtained in a home receiver, and, to give a satisfactory projected picture on the screen, an optical system of enormous light-gathering power is required. A system capable of being used satisfactorily for this application is one which was originally designed for use in an astronomical telescope and is referred to as a Schmidt system.

The Schmidt system, as used for television projection, consists of a large aperture spherical mirror facing the cathode-ray tube, which collects and projects forward a large solid angle of light from the tube, together with an aspheric corrector plate situated at the centre of curvature of the mirror to correct the very large amount of spherical aberration given by the mirror. This corrector plate has a very complicated form of surface and it would be impossible to work this surface to the necessary degree of accuracy in glass at a price

(Continued on page 135.)

Book Reviews

The Story of Plastics. By H. R. Fleck, M.Sc., F.R.I.C. Pp. 96. Burke Publishing Co., Ltd., 6, Carmelite Street, London, E.C.4. 7s. 6d.

This volume is one of a series of popular information books, reviewing various commodities from the aspect of Britain's industrial achievement. It gives a brief account of the birth of the plastics industry, and proceeds to basic facts about plastics. Subsequent sections deal with the chemistry, moulding and application of plastics. The author also discusses the constitution of the plastics industry, and examines the opportunities that exist for administrative and technical knowledge, as well as the qualifications required for those who anticipate obtaining executive posts. The book is not intended to be a technical treatise. In one direction it aims at giving a pictorial survey of the manufacture and use of plastics, numerous illustrations being a notable feature. Yet whilst these illustrations have been selected with due consideration of their purpose, it is regretted that reproduction has left much to be desired. On the whole, they are so poor that they do no justice to the processes and products concerned, and certainly are ill-fitting to accompany the text, which is written in a clear and understandable manner, as one might expect when the author is recognized as an authority upon plastics.

Plastics for Production. By Paul I. Smith. 2nd Edit., revised; pp. 216. Chapman and Hall, Ltd. 15s.

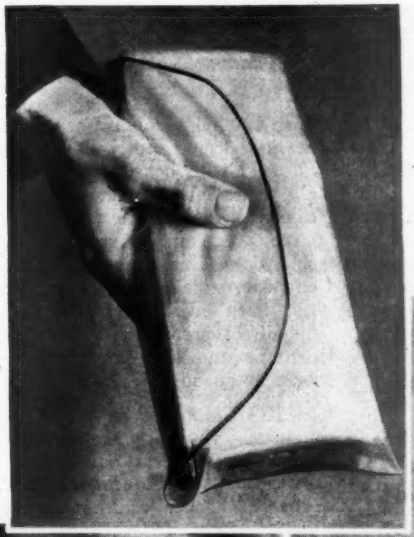
The first edition of this book was published in 1944. The present edition is greatly enlarged, and presents much fresh data on new products and methods of working. Those who read the book will appreciate the many advantages of plastics as materials of construction, but will realize that there are also shortcomings. Indeed, it has been the aim of the author to dispel some of the exaggerated claims which have been made. He is of opinion that the " real future of the plastics industry lies in the marriage of plastics to textiles, metals, wood, glass, etc., and in the setting up within these separate industries of new sections to handle the combinations." After dealing with factors which dictate the choice of a particular material, the author proceeds to give detailed consideration to the available range of plastics and methods of fabricating. The main thermo-setting and thermo-plastic resins have their individual characteristics fully set out in two chapters extending to 74 pages. The remaining chapters treat of mechanically stressed units, electrical insulation, moisture and chemical resistance, light transmission and diffusion, and the effects of temperature on plastics.

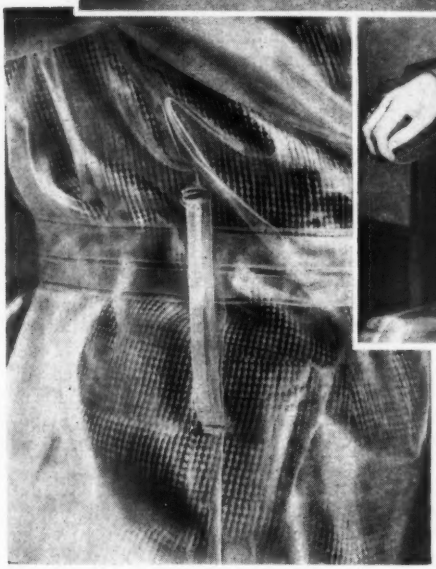
Fire Protection Year Book, 1946-47. Pp. 210. Lomax, Erskine and Co., Ltd., Aldwych House, London, W.C.2. 7s. 6d.

This annual publication was formerly known as "The Fire Protection and A.R.P. Year Book." It has been completely revised in the light of a return to peace conditions, and in its new form provides an invaluable reference book for all whose interests may bring them the need for a knowledge of fire-fighting or fire-preventive measures. The contents are conveniently divided into sections for easy reference by means of stiff finger-tabs. One of the sections deals with legislation in fire-fighting and fire-prevention matters, and includes extracts from the Factories Act, 1937; Fire Service (Emergency Provisions) Act, 1941; regulations for the storage and transport of petroleum spirit; Cellulose Solutions Regulations, 1934; and matters affecting merchant shipping. There is a list of Statutory Rules and Orders of "fire" interest which have been published since 1943. Further sections of the book provide water data (19 pages), details from standard specifications covering fire resistance of building materials and structures, fire classification of timber, and a classified directory of equipment.

Welded Macintosh

IMPROVED PATTERN NOW ON MARKET





(Above) The welding lines are clearly visible. (Left) Both belt and loops are also welded.

Our recent diatribes against the stitched p.v.c. macintosh as being, on the whole, a poor and ill-conceived job, have borne fruit in this latest production. There is no stitching whatever, all joinings being made by high-frequency welding. The garment can be easily and quickly folded and put in its case, which measures only 4½ ins. × 10 ins.

PLASTICS IN GERMANY

The New Target in Germany is the Science behind the Industries. The following are additional Notes from the Official Reports which can be obtained from H.M. Stationery Office

BIOS Final Report No. 629.—This investigation of "synthetic resins used in the German surface coating industry" covers the preparation and general properties of synthetic resins in use in paint, varnish and lacquer. The application of these resins is the subject of a separate report. There are 141 pages, covering over 160 products, as made at 15 works.

BIOS Final Report No. 742.—This report deals with the preparation and polymerization of vinyl ethers and also the preparation of acetaldehyde from methyl vinyl ether, reciting practice by I.G. Farbenindustrie at Ludwigshafen. Equipment and procedure is described and notes are given concerning applications of the products. The soft resins are chiefly used in the adhesives industry, but one of them finds employment for heat-sensitizing Buna emulsions for dipped goods. The harder resins are used as substitutes for natural resins, especially for driving-belt preparations. Of the oily types, one is a good substitute for castor oil in the cellulose-lacquer trade, being one of the few compatible with nitrocellulose.

BIOS Final Report No. 743.—Among other things, this report deals with plant and process for the manufacture of cycloketone resins.

BIOS Final Report No. 750.—This relates to the manufacture of monomeric styrene by the ethylation of benzene, followed by dehydrogenation of ethyl benzene to styrene, as carried out by I.G. at Ludwigshafen. Other methods of manufacture had been examined, but had been abandoned for economic reasons. One of the abandoned processes, however, gave an almost quantitative conversion of phenyl ethyl alcohol to styrene of very high purity, when reflexed with potassium hydroxide. The phenyl ethyl alcohol was prepared by passing 3 per cent. ethylene oxide in nitrogen with benzene (at 5-10 degrees C.), containing aluminium chloride as catalyst. The benzene was maintained in large excess, and one mole of aluminium chloride was necessary for each mole of ethylene oxide reacting. A process had also been investigated (Dr. Reppe) for the direct preparation of styrene from benzene and acetylene, but the yields were not good.

BIOS Final Report No. 751.—Manufacture of vinylacetylene in the I.G. pilot plant at Hoechst is herein briefly described. Of the acetylene fed to the process, 80 per cent. is recovered as vinylacetylene, 15 per cent. as divinylacetylene, and 5 per cent. is lost. Acidified ammoniacal cuprous chloride was the catalyst.

BIOS Final Report No. 756.—Polymeric processes at I.G. Ludwigshafen are described in this report, which reveals certain aspects of activity which might be of special significance in the thermoplastic industry. Three separate grades of polystyrene were made at Ludwigshafen, differing essentially only with respect to molecular weight. The bulk of the present production is "Polystyrol III," which has a K value of 70-72 and a molecular weight, as measured by Svedberg ultra-centrifuge method, of 200,000 (corresponding figure by Standinzer viscometric method, 120,000). This grade is made by a continuous process. The monomer is heated with 0.02 per cent. glacial acetic acid in two aluminium kettles, each 2 cubic m. capacity. The charge for each kettle is 1,200 kg. of styrene, the temperature of which is maintained at 80 degrees C. by means of hot-water jackets, agitation simultaneously effected by paddle stirrers, and oxygen excluded by a stream of nitrogen.

The two vessels are operated in parallel and have an average retention time of two days. During this time, polymerization proceeds to the extent of 33 per cent. completion under influence of heat, no catalysts being used. The partially polymerized syrup is run at the rate of 22 kg. per hr. from each vessel into a single unit, which consists of a tower 80 cm. diameter and 6 m. high. This reaction vessel is made of V2A stainless steel and is fitted with a small reflux condenser and six external heating compartments, the lower sections having coils for the alternative need of heating or cooling. Temperatures are graded from 100 degrees C. in the top section to 180 degrees C. in the bottom half of the reaction vessel. The reaction mixture is held in this tower for 24 hrs., and by the time it has reached the bottom polymerization is quite complete. The polystyrene is extruded in the form of ribbon by two screw machines, and is then broken up in a convenient mill before packing. In order to permit easy extrusion, the very lowest part of the vessel is provided with electrical heating.

Much of the output of "Polystyrol III" was sold for manufacture of "Styroflex," used as an insulating material for submarine and high-frequency cables.

The report deals also with "Oppanols" (poly-iso-butylene and polyvinyl-iso-butyl ether), polythene, vinyl chloride and co-polymers, and "Igamids" (super polyamides); the latter include crystalline fibre-forming polymers. Igamid B strips, as extruded from the reaction vessel, are cold-drawn; the product is said to be superior to leather for driving belts. As a war-time expedient, Igamid 6A was used as a leather substitute, but was inferior in appearance and wear, yet had one advantage in that it could be welded.

BIOS Final Report, No. 781.—Information concerning some synthetic resin moulding plants and processes is given in this report. About two dozen of the better-known German works using thermosetting and thermoplastic materials were visited by the investigators. These plants were nearly all seriously damaged, and were working at only 10 to 20 per cent. capacity. The main conclusion drawn was that there is little for the British plastics moulding industry to learn regarding design, tool design or speedy production methods, but the craftsmanship displayed in tool making and in tool using might well be envied. A range of productions are mentioned. Future trends in machine design were observed at various works, as where feed hoppers were provided with a current of warm air (80 degrees C.) from a perforated air-pipe near the base, and the locking pressure on the tools was arranged by hydraulic operation of a toggle locking mechanism abutting on wedges on the main tie-bars, thus removing the locking stress from the hydraulic cylinder.

BIOS Final Report, No. 842.—Manufacture of synthetic varnish resins and moulding powders at Chemische Werke Albert, Wiesbaden, covered a wide range of products. The synthetic resins used chiefly as raw materials for varnishes and lacquers included combinations of phenolic resins with natural resin acid; mixed esters of phenolic resins; wood-oil reactive alkylphenolics, with special resistance against water, acid and alkali; spirit-soluble phenolics, some of which were employed as binding agent in the production of grinding wheels and brake linings; maleic acid resins, etc. Among special products based on synthetic resins were size for the paper industry based on natural and synthetic resins; phenolic glues for wood; and resin emulsions for the impregnation of yarn and fabric, especially artificial silks, in order to improve the firmness when washing, as also for wind-proofing and to give resistance against putrefaction. Details of various manufacturing procedures are given in the present report. The use of cresol to replace phenol in certain moulding powders during the war receives comment in connection with detailed manufacturing costs.

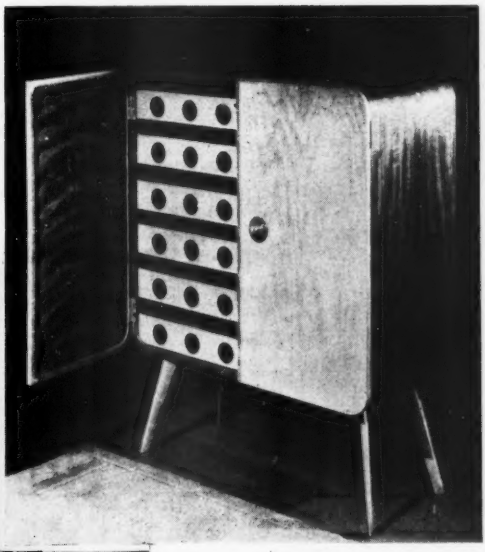
A New Construction for Furniture

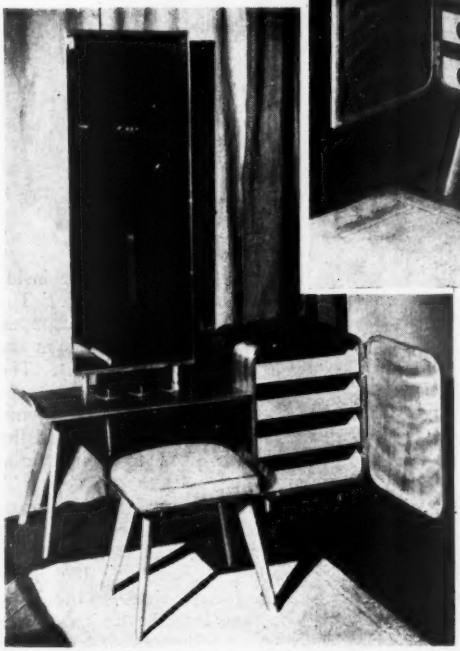
ONE of the least obtrusive uses of plastics is in the synthetic wood glues, which are now used so extensively for plywood and veneering, and in the assembly of furniture. As a result of the development of a plastic adhesive suitable for gluing metal to wood, it is now possible to veneer metal, or to make up a sandwich material consisting of a thin sheet of metal enclosed between two wood veneers. This adhesive, under the name Redux, was developed by Aero Research, Ltd., during the war, and was first used on aircraft and tanks. As might be expected, this use gave it very thorough testing and proved its reliability.

The basic idea behind this new way of making furniture is the combination of the good appearance and gluing properties of wood with the special qualities of metal. This has only now become possible with the development of the plastics adhesive. The composite material is stiff and has the strength of the metal combined with the attractive appearance of the wood. It is free from the "drumming" characteristics of unsupported metal sheets, and from the shrinkage and swelling difficulties of wood. As far as the makers of Redux know, only this particular bonding can give a joint between wood and metal sufficiently strong to withstand the subsequent bending to the small radii required, and which is capable of resisting steaming if desired. It is resistant to the heat and humidity of tropical climates, and because it is a balanced material it does not warp.

This combination of the best in wood and metal is of special significance at the present time because of the scarcity of wood, but its intrinsic merits seem to assure its future. The composite panels are made in a normal steam-heated steel-plate plywood press at 145 degrees C. On removal from the press they can be

Bedroom suite of veneered aluminium, an example of the application of Redux bonding. (By courtesy of Heal and Son, Ltd.)





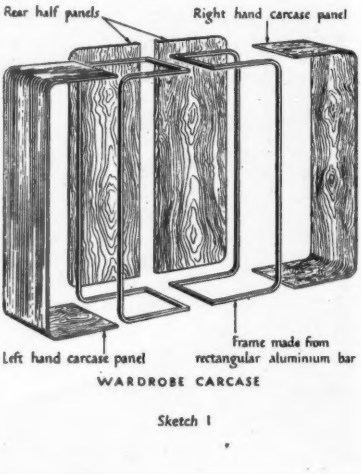
"Tallboy" (right) and dressing table (below) of veneered aluminium with Redux bonding, showing interior fitting. (By courtesy of Heal and Son, Ltd.)

cut and bent as desired. The sharpness of the radius of curvature is limited only by the deformability of the wood veneer, and the plastic bond between the wood and metal will not break.

In the furniture designed by Mr. Clive Latimer for Heal and Son, Ltd., Tottenham Court Road, London, W.1, which we illustrate, the basic principle has been put to good use. This furniture was on view at the recent "Britain Can Make It" Exhibition.

The furniture is made from veneered aluminium panels secured to aluminium frames made from standard bars or angles, cut and bent to shape and welded where necessary. The panels consist of a centre core of 18 s.w.g. Duralumin sheet with a veneer bonded to each side by means of Redux. In the prototype suite of furniture the veneers are walnut, olive ash and masur birch, and some idea of the contrasting effects obtained can be seen from the illustrations. The panels are non-inflammable, and have a useful property by virtue of the excellent heat conductivity of the aluminium; if a lighted cigarette is placed on the veneered metal it will not burn the wood veneer, because the heat is carried away too quickly by the aluminium. The amount of wood used in the furniture is only a small fraction of that used in a suite of conventional wooden construction.

The construction of the furniture was


Rear half panels
Right hand carcase panel
Left hand carcase panel
Frame made from rectangular aluminium bar
WARDROBE CARCASE
Sketch 1
Aluminium door frame made from extruded angles welded at corners.
Birch veneer.
Birch veneer for inside door
Metal sheet between veneers
Olive ash veneer for front of door.
WARDROBE DOOR
Sketch 2

fairly simple because of the ease with which the panels could be curved to shape, in marked contrast to the production of curved plywood which calls for comparatively expensive press moulds, which not only increase the cost of the furniture but make it difficult to depart from standard shapes and to make experimental models. In Mr. Latimer's designs it was necessary to obtain a radius as small as 3 ins., using 18 s.w.g. (0.048 in.) Duralumin with a 1 mm. (0.040 in.) veneer on each side. Where this involved bending the grain it was carried out by soaking the panel in hot water, and then rolling it in the usual sheet-metal rolls.

The wardrobe is a good example of the method of construction used throughout. It was decided that the wardrobe should be made in two parts, bolted together, to allow of easy transport. Each half consists of front and rear frames of rectangular-section aluminium bars, which are bent to the finished shape. The surfaces subsequently to be glued were brushed with Redux liquid and powder, and stoved in an oven at 145 degrees C. for 15 minutes. Aerolite 300 synthetic wood glue was then applied to these primed metal surfaces, and colourless hardener G.B.P. to the inside of the pre-shaped carcase panel. The frame and panel were then clamped together and left for three hours in the workshop to allow the glue to set. The back panel was glued to the rear frame in a similar way. The left- and right-hand halves were then bolted together and the complete carcase fixed to a light cast aluminium base.

In order to avoid screw and rivet heads on the outside of the carcase all the metal internal fittings were "Reduxed" to veneers and glued cold to the inner veneers of the panels with Aerolite 300.

It will be seen that the design of this wardrobe, as also the remainder of the suite, is based upon the use of plastic adhesives. Without them it would have been impossible to veneer the metal sheets for the carcase panels, and without them it would have been necessary to use screws or rivets for fixing the various parts together, and that would have detracted considerably from the appearance of the furniture.

Extruded aluminium-alloy angles were used to make up the frames of the wardrobe doors. Strips of birch veneer were

(*Continued on page* 168)

Five lovely examples of the textile printer's art, on polyvinyl chloride sheet, for use as transparent curtains and other furnishings for nurseries, bathrooms, etc.

Manufactured by Simco Plastics,
22, St. Giles High St., London, W.C.1.

Recent Developments in Radio Frequency Heating

By
D. Warburton Brown,*
A.M.I.A.E.

IT is now some three years ago since George Dring read his paper on high frequency preheating before the London Section of the Institute of the Plastics Industry. This paper was of considerable significance, as it served to bring to the notice of the moulding industry facts, which, although they had been known for some time, had been treated with that degree of reserve which is generally the lot of new scientific developments. Mr. Dring's paper proved beyond doubt the practical value of this method of heating.

Since then, radio frequency preheating of moulding powders has passed from the stage where it was enthusiastically hailed as a cure-all for all moulding production troubles, to the calculated adoption after careful analysis of the economies involved. That it has been widely adopted speaks well for the process. In the early days, operators had little real knowledge of the cost of installing and running radio frequency apparatus. But now moulders know very closely the operating costs of their preheaters.

Originally the process was used almost exclusively for the preheating of thermosetting moulding powders, but with the passage of time, manufacturers of radio frequency apparatus began to look for other fields of application within the plastics industry. With the possible exception of the R.F. sewing machine for seam welding of p.v.c., these developments have received little attention in the technical Press.

It is therefore proposed to describe various applications of radio frequency heating which show promise of commercial success. The various applications to be described will be based on laboratory or production tests. Not in every case have the tests been followed to conclusion, but those that have been included are considered to be worthy of further discussion and investigation.

Before proceeding to more detailed treatment of these applications, however, it is proposed to deal very briefly with the theory underlying R.F. heating.

Theory and Calculations

Any mass of material is composed of a large number of molecules, and, subject to certain properties inherent in the material, each of these constituent molecules can be made to vibrate if the mass of the material is placed in an alternating electric field. Provided the frequency of alternation is sufficiently high, considerable heat is generated in the material due to the internal hysteresis of the material.

In practice, the alternating field is provided by a suitably designed valve oscillator, and the material to be heated is placed between two metal plate electrodes. The electrodes and the material to be heated form a condenser which is connected in the oscillatory circuit. Provided the field is of uniform intensity and the dielectric properties of the material to be heated are the same throughout its mass, the heating will be uniform.

The heating of the material, that is, the rate of heating, depends upon a function known as the loss factor, which is a function of the dielectric constant and power factor of the material thus:—

$$L = K \cos \phi.$$

when L = loss factor.
K = dielectric constant at working frequency.
$\cos \phi$ = power factor at working frequency.

* Delapena and Son, Ltd., Cheltenham.

For general reference, the loss factors of various types of plastics materials are given in Table 1:—

Table 1.—Loss Factors of Various Plastics.

Material	Loss factor
Casein	0.325
Cellulose acetate	0.270
Ethyl cellulose	0.0375
Polymethyl methacrylate	0.0800
Polystyrene	0.0006
Phenol-formaldehyde (G.P.)	0.36
Urea-formaldehyde	0.108
Polyvinyl chloride	0.08

For calculating the size of oscillator required for any application, or the power to heat a given weight of material to a given temperature, the following general approximation is satisfactory: 1 kilowatt will heat 1 lb. of material per minute through 100 degrees C. Higher temperature or greater weights require greater power, and vice versa. For example, to heat 2½ lb. of material through 120 degrees C. in two minutes will require 1½ kilowatts.

Preheating of Moulding Powders

As the pre-heating of thermosetting material is the aspect of radio frequency heating which has received the greatest attention, and as the details of this application are now widely known, it is not proposed to do more than describe briefly the main advantages which accrue from the use of R.F. pre-heating in this sphere. These advantages may be summarized as follows:—

(1) Desired pre-heat temperature can be attained extremely rapidly.

(2) Heating occurs evenly throughout the bulk of the material.

(3) Flowability of the material is enhanced, enabling the mould closing to be accelerated.

(4) Increased flowability reduces the danger of insert and/or pin breakages.

(5) Increased flowability enables lower pressures to be used.

(6) "Curing" cycle is substantially reduced.

(7) Thickness of section of moulding has only limited influence on the cure time.

(8) Danger of trapped gas is reduced, since the vapour is largely driven off during the pre-heat.

(9) Physical and electrical properties of the finished mouldings are improved due to even density.

(10) Finer dimensional tolerances can be maintained due to reduction of "after cure" effects.

The details of this particular application are now so well known and have been dealt with elsewhere so that it is not proposed to devote any further space to this aspect of the subject. Figs. 1-3 illustrate the advantages of R.F. pre-heating in this field.

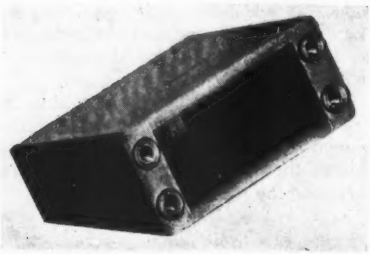


Fig. 1.—Pin breakage on this moulding without R.F. preheating was 6 pins per 1,000. With R.F. 500,000 were moulded without a single pin breakage.

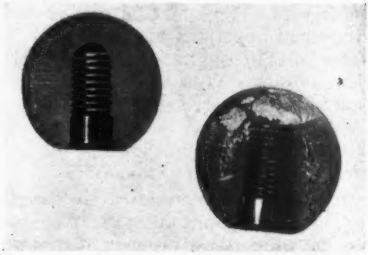
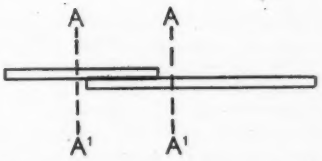


Fig. 2.—Normal curing on this ball-knob by conventional methods is 10 mins. to ensure no distortion. On left, perfect moulding with 3¾ mins. R.F. preheat. On right, imperfect results without R.F. and 4-mins. cure.

Fig. 3.—R.F. heating speeds up production of small pieces.



Weakness occurs at sections AA¹

Fig. 4.—Point of weakness in R.F. seam weld.

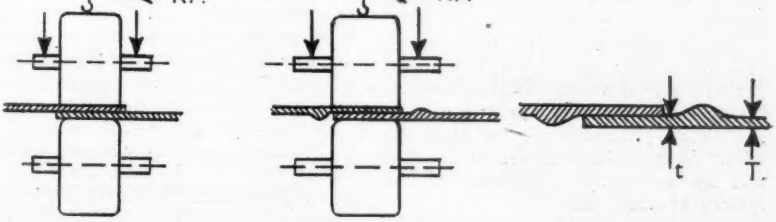
Welding of Thermoplastic Sheets

Another application of radio frequency heating of plastics materials which has enjoyed considerable publicity and adoption is the seam welding of thermoplastic sheets. In particular this process has been applied to the manufacture of a variety of goods made from polyvinyl chloride sheet material. Seam welds of this nature tend to suffer from a weakness occurring at a point just outside the weld area as shown in Fig. 4.

This weakness can be explained if the behaviour of the material being heated is considered. For the purpose of producing seam welds the electrodes are made in the form of rollers, one of which is spring-loaded to apply the pressure necessary to weld the heated material.

Fig. 5(a) represents the condition of the material before the R.F. is switched on, that is, the cold condition. In this case the sheet material is rigid. As soon as the R.F. is switched on the material is subjected to the field and heat is generated. Owing to the fact that the rolls are cool, the maximum heat will be generated at the centre of the joint. As the material heats, it becomes plastic and under the influence of the spring pressure, flows. The way in which this flow takes place is shown in Fig. 5(b), and the final section of the seam is similar to that shown in Fig. 5(c).

The spring pressure causes the material to flow away from the electrodes resulting in a reduction in the thickness of the sheets. Owing to the temperature gradient which exists between the corner of the roller and the surface of the sheet, and the heating effect due to the stray side field, the thinning of the section extends beyond the rollers, so that just at the edge of the weld there occurs a portion of the material whose section is less than that of



(a) Cold condition (b) Hot condition (c) Enlarged section of seam

Fig. 5.—Condition of material during welding.

the parent sheet. This section constitutes a weakness and can cause failure

A possible method of preventing this appears to be to extend the rolls sideways on each side of the weld area, and thus restrict the flow of the material. This would necessitate composite rolls built up from metal and "Mycalex" or polystyrene, as shown in Fig. 6.

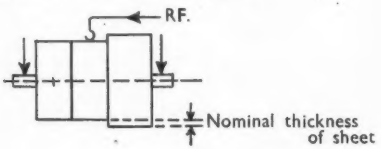


Fig. 6.—Composite roller electrode.

Preheating of P.V.C. Prior to Calendering

The normal method of compounding polyvinyl chloride material prior to calendering may be summarized as follows: The dry components of the mix, which include fillers, stabilizers and lubricants are mixed in a trough mixer and the appropriate quantity of resin is added. Liquid plasticizer is added and the resultant blend which is in the form of a slightly moistened powder is passed to a hot mixer where the colouring matter is added. The heat causes the material to gelatinize into a homogeneous mass. Subsequent working on two-roll hot mixers is required prior to calendering.

Radio frequency heating has been applied successfully to the process, and it has been found possible to apply R.F. to the moistened mix or to the reclaimed granular P.V.C. and to feed the preheated material directly to the calendering rolls. In this way, the intermediate hot-rolling processes can be dispensed with, and in consequence production time can be substantially reduced as can factory overhead charges.

The p.v.c. in powder or granular form is placed in polystyrene, polythene or other low loss material containers and the heated "cakes" are fed directly to the calender. The p.v.c. heats very rapidly and no difficulty need be experienced in keeping the calenders in continuous operation. If so desired, a belt conveyor feed running through the preheater can be arranged.

R.F. Preheating of Laminated Plastics

The use of R.F. for the manufacture of laminated plastics has been advocated for a number of years, but the suggestions have always been on the basis of the simultaneous application of R.F. and pressure. Practical experience has shown that this is inadvisable, as there is a tendency for severe burning to occur in the centre of the block of material. This is probably due to pockets of trapped moisture which cause concentrations of R.F. and consequently local overheating.

More satisfactory results have been obtained by preheating the stacks of impregnated material and completing the "cure" by pressing in the normal manner. Although no full-scale experiments have been carried out along these lines, several small specimens have been produced, the final material being of somewhat higher quality than that made by normal means.

Several samples were made using an impregnated paper base. These consisted of 50 pieces measuring 3 ins. by 3 ins. by 0.008 in. thick, and the generator used was one having 300 watts output at 6.0 megacycles. The best results were obtained using prewarmed electrodes and applying 250 watts to the load for 3 mins. This figure compares with approximately 20-30 mins. using the conventional production methods.

Promising results have been obtained on rod and tube material, and there

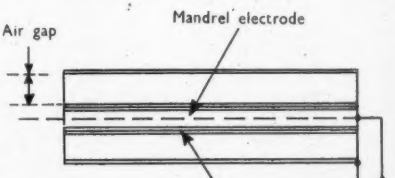


Fig. 7.—Electrode arrangement for laminated tube.

appears to be an excellent application for R.F. in this direction. Samples have been made with 1.00 in. diam. linen base rod on which 8 mins. application of R.F. has rendered the material sufficiently hot to complete bonding by means of pressing between a hardwood split mould.

Tubes can be made using the mandrel for one electrode and a tube as the second electrode. This is illustrated diagrammatically in Fig. 7.

Gluing of Timber

Radio frequency heating has been successfully applied to the rapid hardening of glued joints in timber constructions, such as furniture and wooden boat hulls. In practice, the application of radio frequency to this type of work has resulted in very substantial reductions in production times being achieved, and it is found that in some cases the setting time required may be as low as 0.1 per cent. of the time which is required when using the normal production methods. In addition to the speeding up of the gluing process, it has been found that with synthetic resin adhesives of the urea formaldehyde type, the resultant joints are slightly stronger when using R.F. heating. The joint to be cured is placed in an alternating R.F. field of frequencies varying between 1 and 30 mc/s. per second, and the electrode plates which are made to take the form of clamping jigs, are arranged so that the length of the glue line is perpendicular to the face of the electrodes. Several joints may be cured simultaneously by suitably designing the electrode and clamping jigs. Owing to the relative electrical properties of the wood and the glue line, the heat will concentrate in the adhesive, and with suitably designed electrode arrangements the temperature of the wood need never rise above 50 degrees C.

For the purposes of assessing the quantity of radio frequency power required to carry out any particular application, the following approximation may be used: 1 kW. of radio frequency power will completely cure 100 sq. ins. of glue per minute, and it will be seen from the following examples that this approximation is sufficiently accurate for preliminary discussions.

It should, however, be realized that the type of resin employed and the type of accelerators used have a considerable influence upon the time required for setting, and in practice it has been found that the minimum time for setting glued joints should not be less than 3 minutes.

EXAMPLE 1. VENEERING OF PLYWOOD

Wood veneers measuring 6 by 6 ins. and having 11 glue lines had to be compressed and cured using a 750-watt radio frequency generator. The total glue area involved is about 400 sq. ins., and the time taken using a urea formaldehyde synthetic adhesive was found to be 5 minutes. This is equivalent to 110 sq. ins. per kW. per minute.

EXAMPLE 2. GLUING WOODEN BLOCKS

Wooden blocks, measuring 8 by 12 ins. and having 14 glue lines, were cured on a 1 kW. generator in 10 minutes. As the total glue area in this case amounted to 1,340 sq. ins., the power per minute may be expressed as 134 sq. ins. per kW. per minute.

Preheating of Rubber

The principles which govern the heating of plastics materials by radio frequency also hold good in the main for various types of rubber, although the process is rather slower than in the case of plastics. The success or otherwise of radio frequency in the rubber field depends to a great extent on the constituents of the rubber mix, and the percentage of carbon black which is present is a decisive factor. Heavily loaded rubber tends to flash over when subjected to a radio frequency field. With suitable grades of rubber, however, it is possible to achieve very appreciable production savings, as may be judged from the following examples:—

A thick rubber moulding which normally took from 45 to 50 minutes in the press was found to be satisfactorily cured after an 8 to 10 minutes R.F. preheat, followed by 20 minutes pressing time, so that the effective reduction in press time was almost half an hour.

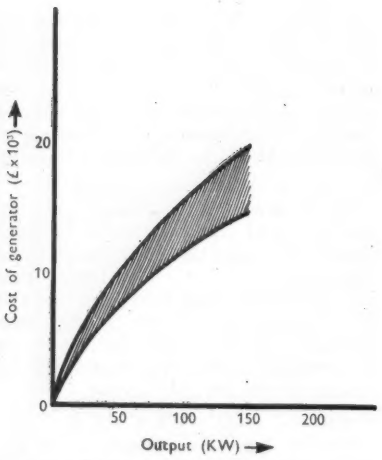


Fig. 8.—Cost of R.F. generators per kW. output.

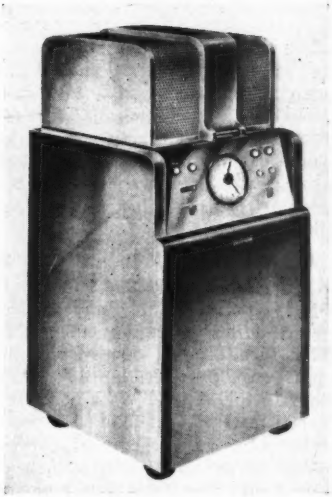


Fig. 9. — The "Deltron" D.10 Plastics Preheater.

As has already been pointed out, the constituents of the mix play a very important part in determining the suitability or otherwise of the rubber for radio frequency heating, and in some cases rubbers will not heat at all when subjected to R.F. current. Work is still in process to endeavour to determine the common factor which determines suitability of rubbers for heating by this method.

Initial and Operating Costs

There has been very little reliable information published concerning the operating costs for radio frequency heating apparatus, and as this aspect is of first importance to the user of the equipment, the following example is given as an indication of the costs involved using a 2 kW. generator.

The following notes are given concerning the initial cost of the equipment.

There are a number of different makes and types of radio frequency heating apparatus on the market, and these cover a fairly wide range of prices, but the curve shown in Fig. 8 gives a rough idea of the initial cost of the generators for different power outputs. It will be seen from these curves that the initial cost of high-powered generators does not vary so rapidly as those of lower capacities.

Returning to the question of operating costs, the following figures have been obtained from the Deltron D.10 2 kW. generator. Operating costs may be considered to consist of the following items:—

(1) Power cost.
(2) Valve replacement cost.
(3) Depreciation.

COST OF CURRENT

(a) *Filament Power.* For the purpose of calculations the filaments are assumed to work 80 per cent. of the time at full voltage and 20 per cent. at half voltage. The consumption of the two valves working at full voltage is equal to 600 watts and at half voltage 300 watts.

80 per cent. at 600 w. = 480 w.
20 per cent. at 300 w. = 60 w.

540 w.

Therefore, filament power = 0.540 kW.h.

(b) *Anode Power.* True anode power, assuming that the set is in operation for 80 per cent. of total working time, is

$$5.2 \times \frac{80}{100} = 4.16 \text{ kW.h.}$$

Therefore, total power consumption
= (filament power + anode power)
= (0.540 + 4.16)
= 4.70 kW.h.

Assuming power at the rate of 1d. per unit, the operating cost of the set for power consumption only is roughly 4¾d. per hour.

VALVE REPLACEMENT

The valve replacement costs are based on the assumption that the useful life of the valves is 2,500 working hours, and the cost of the valves is £25 each.

Therefore, cost per hour

$$= \frac{25 \times 2 \times 20 \times 12}{2{,}500}$$

= 4.8 pence per hour.

DEPRECIATION

With the recent development in the radio frequency field, write-off of capital expenditure has been assumed over a four years' period. A useful working period of 120 hours per week (5,000 hours per year) has been assumed. Therefore depreciation costs per hour

$$= \frac{500 \times 20 \times 12}{4 \times 5{,}000} = 6 \text{ pence per hour.}$$

From the above calculations it will be seen that the total operating costs for a 2 kw. R.F. generator may be summarized as follows:—

	Pence per hour
Power costs	4¾
Valve replacement costs ..	5
Depreciation	6
	15¾

If the same life is assumed for the rectifier valves and terminal delay switch valve which is incorporated in the circuit, this operating cost lies between 1s. 6d. and 2s. per hour.

MODERN APPLICATIONS OF PLASTIC OPTICAL MATERIALS

(Continued from page 121)

which would allow it to be used in domestic television receivers. Once the moulds for this corrector plate and the mirror have been prepared, however, the two components could be made cheaply in "Transpex" 1 by the "surface-finishing" process.

Although I.C.I. have concentrated to a large extent on television projection prototype systems, they are also working on other types of system with a view to production on a manufacturing scale. These include:—

(a) "Searchlight" railway signal systems, in which the majority of light from a small lamp is projected forward through a coloured "roundel," the coloured light thus produced then being collected by an aspheric lens system and projected down the track as an intense parallel beam.

(b) Aspheric industrial inspection lenses to magnify tiny machined parts.

(c) Ellipsoidal condensing mirrors for use in film projectors, epidiascopes, etc., which collect most of the light from a lamp and condense it on to the film or object to be projected.

(d) Microfilm projectors, to allow photographs of documents on photographic film to be enlarged up to full size and thus read without prints having to be made.

(e) "Rapid" camera lenses of the order of f/1, which will greatly reduce the exposure time required.

(f) "Deep" parabolic mirrors.

(g) Lightweight binocular prisms.

All these systems and components, which may be required in substantial quantities, are particularly suitable for manufacture by the "surface-finishing" process.

World's Industry Employs Plastics

GENERAL ENGINEERING

Mechanical test methods for better plastics design are discussed in "Product Engineering" (1947 / **18** / 113). Modifications of the standard flexural and impact tests for moulded plastics are proposed. Impact evaluation as an area under a flexural curve, and the relation of notched and unnotched specimens to finished product receives attention. The Izod test for plastics is similar to that of steel, except that the machine is lighter and specimens slightly different. Impact energy is consumed by breaking the specimen, by deforming the machine base and fittings, and by throwing the broken end of the specimen to a distance of several feet.

Model engineering and craftsmanship with plastic models is being directed to the useful purpose of helping the blind. The method is illustrated and explained in "Mechanics" (1947/Jan. 10/246).

Aspects of the plastics industry are discussed in "Mechanics" (1947/Jan. 17/261 and 1947/Jan. 24/285). Possibilities of plastic bonding are mentioned. Attention is also drawn to developments in applying layers of protective plastic especially by the flame spraying of plastic in a special gun which was perfected for the spraying of metal powder.

Plastic gauges and other small parts are being increasingly used in metal-working shops. (Machine Tool Blue Book, 1947/**43**/242.) Equipment and materials needed for low-cost plastics handling, and the operational procedure to be followed in setting up an inexpensive small plastics department, are discussed. Moulds can be made economically, due to the new elastomer or rubber-like mould materials, such as Plastiflex, developed by Calresin Corporation. Whenever plastics are used to fabricate gauges whose dimensions should be within 0.005 in., it is well to make oversize patterns and moulds so that critical dimensions can be achieved by machining.

Fiberglas-reinforced plastics provide a combination of properties which are highly desirable in engineering material. The "Forty-Six" car was built with a combined Fiberglas-plastic body. In joining the different parts the surfaces were roughened and painted with a film of resin. ("Automotive and Aviation Industries," 1946/**95**/45.)

Aircraft parts made of Fiberglas-reinforced plastics illustrate adaptability of this material for complex compound-curves, as done by Industrial Plastics Corporation, California. ("Product Engineering," 1947/**18**/104.)

Protection for industrial products by a new method of processing plastic material is announced by General Electric Co., Pittsfield, Mass. ("Machinist," 1947/**90**/1652.) Possessing good electrical, physical and chemical properties, the new material is available in the form of caps and sleeves which are expanded by immersion in a solution for two to four hours. The protecting unit is then placed in position and allowed to dry. It shrinks to dimensions smaller than the original size, and provides tight-fitting protection around the product. Removal is effected by cutting with a knife.

Ornamental turning applied to plastics is discussed in "Mechanics" (1947/Jan. 24/287). The author has previously engaged in the turning of wood, metal, etc., but has now directed his attention to plastics.

Tumbling barrels made of Du Pont

"Lucite" (acrylic resin) have been developed by the Hardwood Line Co., of Chicago. These barrels are one-piece constructions and have no ribs. The ends are cemented to the side walls. The barrels are non-conducting and able to resist chemical action. Previously, hard rubber has been used fairly extensively. ("Machinery Lloyd," 1947/Feb. 1/70.)

Low-cost dies for forming soft metals, such as aluminium and magnesium, are advantageously made of plastics. This subject was discussed at a joint meeting of A.S.T.E. and A.S.M.E. in November, 1946. ("Tool Engineer," 1947/Jan./56.)

MISCELLANEOUS

Transfer moulding has profited by developments in high-frequency dielectric heating. It is especially suitable where fragile inserts, high dimensional accuracy and low mould cost are important factors in design. The surface obtained is hard and lustrous and superior to buffed surface in resistance to everyday wear. ("Machinist," 1947/**90**/1567.)

Interior panels of plastics are described in "Automotive and Aviation Industries" (1947/**96**/32). The process for incorporating photographic reproductions of leather, wood, and fabric patterns in a plastic finish for automobile interior panels has been used by the Briggs Manufacturing Co. The new process sandwiches actual photographic reproductions between durable plastic sheet using an impregnated core stock of wood pulp, rag board and sisal fibre.

Thermosetting silicone resin for bonding applications has been developed by the Dow Corning Corporation in the form of a 60 per cent. solution of silicone resin in toluene. It is heat stable, waterproof, and has dielectric properties. The resin can be used for bonding finely divided particles, such as powdered metals, carbon, etc. ("Materials and Methods," 1947/**25**/138.)

Foamed cellulose acetate is being produced by Plastics Division of Du Pont Co. ("Materials and Methods," 1947/**25**/58). This material is lighter than cork, but when bonded between two sheets of metal, wood or plastic contributes structural strength. It is thermoplastic, and produced by extrusion. It may be shaped while at softening point. Properties and various applications are enumerated.

Trends in exploitation display for cinema films by employment of plastics and silk screen are discussed by L. Wallace ("Kinematograph Weekly," 1946/Jan. 9/10). "Perspex" and similar malleable transparencies, plastic fabrics, special sprays produce desired effects.

Nylon manufacture, from carbon to the finished product, is described in "Popular Science" (1946/Dec./132). Du Pont anticipate a production of 23,000,000 lb. of the thread annually; this would be capable of making 450 million pairs of stockings.

Fiberglas-resin low-pressure laminate has been investigated as a cover for a stretching die employed by Flexible Co., Loudonville, Ohio, who are makers of car bodies. This has led to a decision to cover all stretching dies of this type with a laminate made from similar material. ("Product Engineering," 1946/Dec./57.)

Patterns made from cast plastics are described in "Materials and Methods" (1946/**24**/1466). Cast resins offer many advantages as materials for foundry patterns, including initial cost, ease of casting, and inexpensive finishing. Liquid phenolic casting resins which are available are nearly all of similar physical property. They can be cast in moulds made of plastics, wood, metal, rubber or latex. Handling is fundamentally the same for all types of moulds, but preparation prior to filling may vary. Patterns made of cast resin can be easily machined, using standard machine shop equipment.

Halogenated Polythenes (Contd.)

By E. E. HALLS

In this concluding instalment the author gives the result of further searches in the patent literature regarding the manufacture of the chlorinated polythenes.

THE preparation of copolymers by interpolymerizing a mixture of 30 to 98 per cent. by weight of monomeric methacrylic acid and 70 to 2 per cent. of another polymerizable material such as unsymmetrical dichloroethylene is proposed in British Patent No. 532,308. This is said to be possible in aqueous dispersion with an oxygen-containing substance as catalyst, e.g., ammonium persulphate.

B.P. No. 575,616 provides a modification to No. 573,369, whereby a water soluble thiosulphate is used instead of the water soluble compound capable of taking up molecular oxygen. Sodium, potassium or ammonium thiosulphates are suggested. In other respects, the procedure is as in B.P. No. 573,369. It is preferred that the aqueous medium be faintly alkaline, but it may be weakly acid. In this latter case, it is understood that the water soluble salts, e.g., sodium thiosulphate, may not exist in the solution in the form in which they were added.

Where the catalyst capable of taking up molecular oxygen was used, the increase in rate of polymerization was greater than that to be expected by the removal of molecular oxygen, which interferes with polymerization. Using the thiosulphate, which does not remove molecular oxygen, the latter can be displaced from the reaction zone by replacement with an inert gas such as nitrogen. Examples are given as under:—

(1) One hundred parts of asymmetrical dichloroethylene are added to 300 parts of an aqueous solution of 3 parts of the sodium salt of sulphated sperm oil alcohols, 3 parts of ammonium persulphate, 1 part of caustic soda, and 1.5 parts of sodium thiosulphate. This mixture is agitated in a nitrogen atmosphere in a vessel maintained at 30 degrees C. In 5½ hours, the product is a mobile, partially coagulated emulsion, and it is removed from the reaction vessel and 100-150 parts of brine are added to it. Poly asymmetrical dichloroethylene is obtained as a finely divided white powder, easily filterable. It is filtered, washed and dried at 35 degrees C., and 85 per cent. of theoretical yield is obtained. If the thiosulphate is omitted, the yield is only 12 per cent., other conditions being the same. Again, including the thiosulphate but omitting to replace air by nitrogen in the reaction zone, the yield is only 47 per cent. in the same processing time.

(2) Six hundred parts of an aqueous solution of 6 parts of the sodium salt of sulphated sperm oil alcohols, 6 parts of ammonium persulphate, 4.2 parts of sodium bicarbonate and 3 parts of sodium thiosulphate, 120 parts of asymmetrical dichloroethylene and 80 parts of vinyl chloride are charged in this order into an evacuated pressure vessel. The vessel, maintained at 30 degrees C., is rotated end over end for five hours. The polymer is then isolated as in the previous example. The yield is 200 parts of a white amorphous powdery copolymer of dichloroethylene and vinyl chloride, i.e., 100 per cent. theoretical yield.

From these data, it is seen that solid products are procured, the raw material being either asymmetrical dichloroethylene, or a copolymerizable mixture with a material such as vinyl chloride.

Chlorinated Polythenes

British patent No. 575,096 (1946), of Imperial Chemical Industries, Ltd., J. R. Myles and P. J. Garner, covers improvements in the manufacture of chlorinated polythenes. Some of the claims made in this invention are summarized.

(1) A manufacturing process for chlorinated polythenes in which solid or semi-solid polythenes are subjected to the action of chlorine in the presence of an inert liquid medium, with the reaction zone illuminated by sunlight or artificial light, preferably rich in green and yellow. The reaction is carried out in the presence of not more than a small amount of oxygen, and, at least, part of the heat of reaction is removed.

(2) A process, such as (1), in which the air is removed from the reaction zone before chlorination, by means of a stream of inert gas.

(3) A process as in the foregoing, with the reaction mixture agitated and the liberated hydrogen chloride removed.

(4) A continuous process as above, in which the chlorine and the solution or suspension of polythene in an inert medium are fed continuously into the reaction zone, or zones, at pre-selected rates, and the products are removed continuously at corresponding rates.

(5) A process as above, in which carbon tetrachloride is the inert medium, and this medium is recycled after separating it from the chlorinated polythene and purifying it, if necessary.

(6) Chlorinated polythenes made by these processes, shaped and coated articles made from such chlorinated polythene by extrusion moulding, pressure moulding, or the application of the chlorinated polythene in the form of a paste, dispersion, emulsion or solution to a mould or base.

The term "polythene" includes the solid and semi-solid polymers of ethylene. B.P. No. 481,515 already covers the halogenation of solid polymers of ethylene by subjecting them to the action of free halogen or of certain halogen compounds, and the semi-solid polymers may be halogenated similarly.

The patent indicates that for constructional convenience it is usual to carry out such chlorination processes on a large scale, using plant of porcelain, corrosion-resistant metal or other opaque material. In the chlorination of polythene the rate of reaction at room temperature in such apparatus is slow, and to introduce 20 per cent. of chlorine requires many hours of reaction. The reaction is more rapid at higher temperatures, especially when solvents, such as carbon tetrachloride, are used. Time is still lengthy, and products containing 45 per cent. of chlorine still require many hours of chlorination. Much longer times are required when non-solvents are used as the dispersing medium. The object of the present invention is to overcome these difficulties by providing an improved technique which gives an increase in the rate of chlorination at all temperatures and products of higher chlorine content; for example, 75 per cent. of chlorine by weight.

The improvement is based on the discovery that appreciably accelerated reaction is obtained by illuminating the reaction zone with sunlight or artificial light. Further, when a reaction is carried out under these conditions, the presence of the usual amounts of air or oxygen in the reagents or vessels is harmful, because it inhibits the illuminated reaction. Again, with the rapid reaction, the normal rate of heat loss is too slow to maintain the temperature below the desired limit. It is, therefore, necessary to use artificial cooling. Therefore, it will be noted that, in carrying out the illuminated reaction, precautions are essential that are unnecessary in the absence of such illumination.

Summarizing, the new processes for manufacturing chlorinated polythenes involve the chlorination of solid or semi-solid polythenes, in the presence of an inert liquid medium with the reaction zone illuminated by sunlight or artificial light, with a maximum limit on the amount of oxygen present and controlled removal of the heat of reaction. It also involves the removal of the hydrogen chloride as it is formed, agitating the reaction mixture, removing the inert liquid from the chlorinated polythenes, and operating in a continuous manner. Further, the polythene may be suspended in a finely divided state in the liquid medium.

The object of the liquid medium is to render the polythene readily attacked by the chlorine, by having the polythene in the dissolved or dispersed state. The liquid must not interfere with the reaction, and preference is given to a colourless liquid in which the polythene is soluble when hot; for example, carbon tetrachloride. Other liquids which may be used include water, trichloracetic acid, chloroform, hexachlorethane, hexachlorbenzene and other liquids which are not appreciably chlorinated during the reaction.

The patent indicates that the bulk of the air, or oxygen, must be displaced from the reaction mixture, because, otherwise, the reaction is initially delayed and then may proceed too rapidly. Air can be swept out of the reaction vessel itself by a rapid stream of any gas, substantially free from oxygen. The quantity of air or oxygen normally dissolved in the liquid medium, especially a medium which dissolves polythene when hot, causes considerable induction period. Thus, using carbon tetrachloride, the delay occurs until the chlorine builds up to about 7 grams in 100 c.c., and then the reaction proceeds with uncontrolled violence, especially at temperatures below about 50 degrees C. This is avoided by removing the air, for example, by boiling the inert medium and allowing it to cool in a stream of gas which is substantially free from molecular oxygen. An alternative is to use freshly distilled medium in the absence of air.

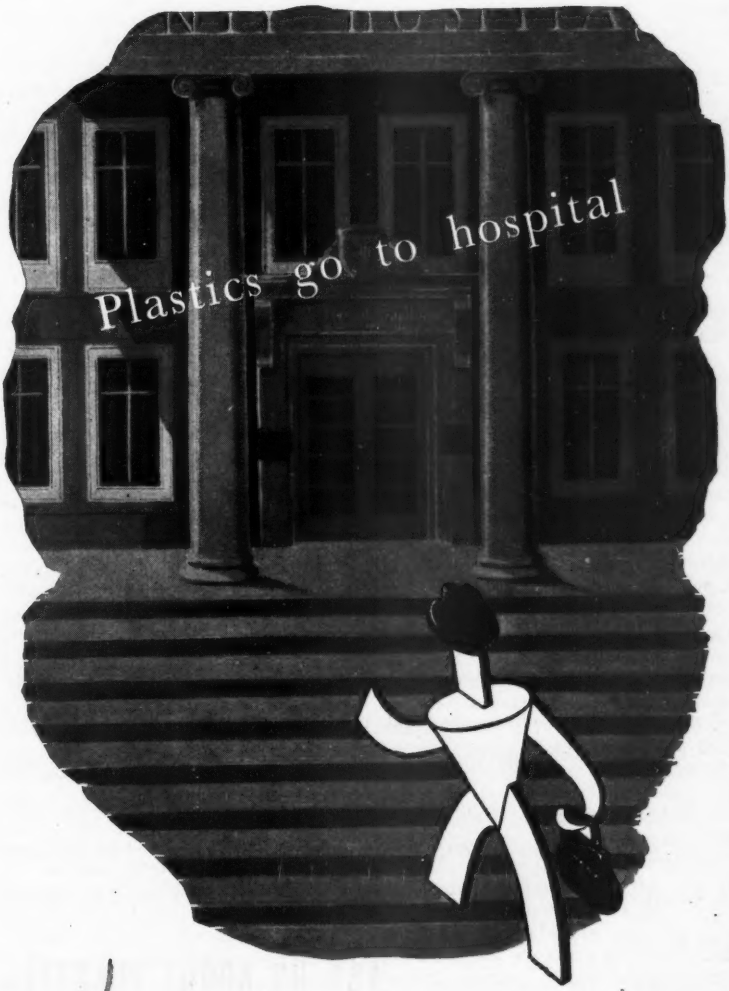
The chlorination is more rapid and less subject to an induction period if carried out about 50 degrees C., in which case it is generally sufficient to sweep the air from the gas space with a stream of suitable gas. The effect of a trace of oxygen in commercial chlorine is negligible compared with that of the air in the reaction vessel and in the liquid medium, but after reaction has proceeded for some time, the amount of oxygen in the reaction zone is determined by that entering with the chlorine. A trace of oxygen in the chlorine, such as 0.001-0.05 per cent., may be desirable to catalyse the reaction; an excessive quantity, such as 0.5 per cent. and higher, has an inhibiting effect, and tends to degrade the polymer, giving a product of low molecular weight, which is not always desirable. Therefore the chlorine should be free from oxygen and generally not contain more than 0.2 per cent. by volume.

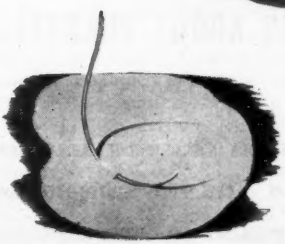
Sunlight is effective, but not generally convenient, as the illuminant for large-scale manufacture. Artificial light should not have a high proportion of ultra-violet radiation, because although this gives a high rate of reaction, it tends to yield opaque or insoluble products, especially with long exposures, such as two to five hours, which are required for products of high chlorine content; for example, 50-60 per cent. chlorine by weight. One suitable source of illumination is a daylight fluorescent tube, because this is rich in green and yellow of wavelength 4785A and below.

An alternative is to screen the illumination with a transparent yellow screen, which removes undesirable wavelengths without affecting the useful ones.

Intensity is not critical. Even small intensities such as 50 candle-power/10 litres of reaction space have a substantial effect upon the efficiency and rate of chlorination, and further increases beyond 1,000 candle-power/10 litres have very little effect. The intensity also depends upon the rate of input of chlorine, the shape of the reaction chamber, and distance from the light source, and upon any other factors that may impede the passage of the light to the reaction zone. It is convenient to use an apparatus which has one or more glass walls, so that the illumination is well spread throughout the reaction zone. Any substantial heating effect by the illumination is undesirable, because it tends to cause film formation on the glass walls and obscure the passage of light.

The following figures illustrate the accelerating influence of the illumination: Chlorine conversion is increased from about 30 per cent. to 50-90 per cent. of





Plastics from I.C.I. are entering the professions. Nylon monofilament non-absorbable surgical sutures are in universal use for external applications. Because they are strong, uniform, dependable—and inexpensive.

ICI

P.244

will it be plastic?

When his dreams of growing up come true will he dance on a plastic floor, sleep beneath plastic sheets, drive a plastic car? "Everything is going to be plastic soon," they say. We don't go as far as that. What we do say is this, "Some things are better made of plastic than of anything else. But plastic is not metal, nor is it wood, nor glass, nor rubber. Plastic is plastic, and proud of it!" And we are proud of the fact that our research and technical departments have their feet firmly on the ground. They are discovering new uses for plastics in all branches of industry and are putting plastics to work where they are not only the least expensive but also the best materials for the job in hand.

ASK US ABOUT PLASTICS

F. A. HUGHES & CO. LIMITED, ABBEY HOUSE, BAKER STREET, LONDON, N.W.1. 'PHONE: WELBECK 2332

BRITISH RESIN PRODUCTS LIMITED, TONBRIDGE, KENT ● CELLOMOLD LIMITED, FELTHAM, MIDDLESEX ● EXTRUDED PLASTICS LIMITED, FELTHAM, MIDDLESEX ● INDURITE MOULDING POWDERS LIMITED, RADCLIFFE, MANCHESTER.

that passed through. The time for a product containing 50 per cent. chlorine is reduced 3-10 hours to 1-3 hours.

The amount of heat evolved is about 850 calories per gram of chlorine reacted, half this chlorine entering the polythene molecule and half combining with the displaced hydrogen. It is impossible to control the reaction to yield desirable products unless part of this heat is removed. The most desirable products contain at least 25 per cent. of chlorine, most of which should be introduced below 40 degrees C. A polythene concentration of 5-8 grams, in 100 c.c. is most suitable, and the chlorination of this would give a temperature rise exceeding 80 degrees C. with carbon tetrachloride as the medium. Using water as the medium, without any cooling, the rise would be from 30-150 degrees C., for chlorination from 25-65 per cent. Controlled cooling is therefore essential, particularly during the intermediate stages of the chlorination.

The degree of control is governed by the product required; for example, a hard product of 50-75 per cent. chlorine is produced with most of the chlorine reacting at 20-40 degrees C. If prepared at 50-80 degrees C., the product is softer and stickier. Again, an elastic material of 30 per cent. chlorine is prepared at 50-80 degrees C., whereas a flexible, but not appreciably elastic one of the same chlorine content, is prepared at 20-40 degrees C.

Good agitation is necessary with a high rate of chlorine absorption. This also assists in the steady removal of heat, and, in the case of suspensions, in exposing fresh surfaces to the chlorine and light.

The method for polythene suspensions is described as follows:—The polythene is dissolved in hot carbon tetrachloride and the solution is cooled with brisk stirring to give a cold suspension of finely divided polythene in the carbon tetrachloride. The bulk of the air is displaced from the reaction vessel while cooling, by passing a stream of carbon dioxide, or of chlorine, through in the dark. The reaction zone is then illuminated. Chlorine gas is bubbled through. The issuing gas, consisting of hydrogen chloride and excess chlorine, is removed and the temperature of the reaction is controlled by cold-water coils. The amount of chlorine combined with the polythene is determined by measuring the amount of hydrogen chloride removed, and when the desired reaction is complete, the reaction mixture is passed into hot water. The carbon tetrachloride is removed by distillation and the white solid floating on the water is strained and dried.

The reaction may be carried out at a higher temperature, with the polythene dissolved in the carbon tetrachloride, or suspended in a non-solvent. The chlorinated product may be recovered from the hot carbon tetrachloride solution by addition of a liquid such as alcohol, which is miscible with carbon tetrachloride, but is a non-solvent for chlorinated polythene. Using this method, it is essential to remove residual traces of chlorine and hydrogen chloride from the mixture before it is separated, as otherwise the product is less stable upon exposure to heat and light.

This process may be carried out in a single vessel or a series of vessels, or it may be converted into a continuous arrangement.

It is stated the chlorinated polythenes containing more than 25 per cent. of chlorine are non-inflammable. Hot chlorination generally produces soft, rubbery, plastic, and more easily soluble products, than those obtained from cold chlorination. Those from the cold process and containing 30-40 per cent. of chlorine are suitable for use in extrusion and other hot moulding processes to give flexible objects. With higher chlorine contents, rigid articles of high-tensile strength can be compression moulded at about 160 degrees C.

In solutions, the products may be used as varnishes and for making supported or unsupported films by already known methods. Such films can conveniently be made at elevated temperature to facilitate the removal of the solvent and to increase the coherence of the film.

The products are also useful in the form of paste, dispersions and emulsions for coating and impregnating processes. These pastes can be obtained from powders and applied by spreading and heating to 110-120 degrees C. in order to homogenize the chlorinated polythene by removing the liquid medium and coagulating the particles. Finely divided fillers, colours, stabilizers, plasticizers and other thermoplastic materials may be incorporated.

Finished articles may be hot-pressed at 120 degrees C. to give surface polish, and threads and films can be strengthened by hot or cold drawing under sufficient tension to exceed the yield point at the temperature of drawing. Articles can be welded using filler rods of ⅛ in. diameter, heated by air at 250 degrees C., and squeezing the rod into the gap to effect a joint.

As an example of the process, the following details are given:—800 grams. of polythene of molecular weight 10,000, is dissolved by boiling in 10 litres of carbon tetrachloride, and the hot solution is passed to a glass vessel fitted with a stirrer and cooling coils. The solution is cooled quickly with rapid stirring. Crystallization starts at 55 degrees C. and the suspension is cooled at 25 degrees C. Air is displaced from the vessel by passing carbon dioxide during the boiling and subsequent cooling. The carbon dioxide is then replaced by chlorine containing 0.1 per cent. of oxygen at 15 grams./minute with stirring, and the reaction zone is illuminated with a 1,000 candle-power light, rich in wave-lengths of 4785A and less. The flow of cooling water is controlled to maintain a temperature from 20-35 degrees C. The hydrogen chloride liberated is removed and collected to measure the amount of reaction. After 2 hours the cooling water is stopped, and shortly afterwards the stream of chlorine and the illumination are stopped. The reaction mixture is poured slowly into hot water and the carbon tetrachloride distilled off. The white solid floating on the water is isolated and dried to give a product of 50 per cent. chlorine by weight. This is suitable for moulding by conventional methods into stiff flexible articles.

It is seen that there is wide flexibility of process in the chlorination of polymerized ethylene. Treatment in solution or in emulsion form; treatment hot or cold; degree of chlorination: all these have considerable bearing upon the physical and mechanical properties of the product. The applications indicated illustrate the possibility of wide fields of operation. In contrast with the highly fluorinated material, a highly thermal resistant plastic is not obtained, but, on the other hand, the qualities manipulability are not sacrificed.

One direction in which a varnish having chlorinated polythene as the base has shown outstanding merit is for the sealing of small electrical coils. The technique for this purpose is to take the coils, wound in the normal way, for example, having enamelled copper wire windings, and plain paper insulation over the metallic core and between windings. These are pre-dried in the orthodox manner in an air-circulating oven, time dependent upon load, e.g., 3 hours minimum at 110-120 degrees C. They are then vacuum-pressure impregnated in a good coil varnish, drained and baked, e.g., 12 hours minimum at 110-120 degrees C. Next, to fill cavities, which are inevitable, an ordinary metal finishing surface of the stoving synthetic type is applied by dipping, two coats being given and each set by stoving for ½ hour to 2 hours at 110-120 degrees C. Finally, one or more sealing coats of the chloropolyethylene type of varnish are applied by dipping, and each coat is force dried in an air-circulating oven at 60-70 degrees C.

On complicated windings, this treatment gives very good results, not only withstanding the wet cycle tests (100 per cent. humidity at 60 degrees C.) of W.T. specification K110, but giving satisfactory performance on continued exposure to warm humidity with a potential between windings and core. The treatment is not so involved as would appear at first sight, because there is only one vacuum varnish

(Continued on page 168)

'Celastoid'

TRADE MARK

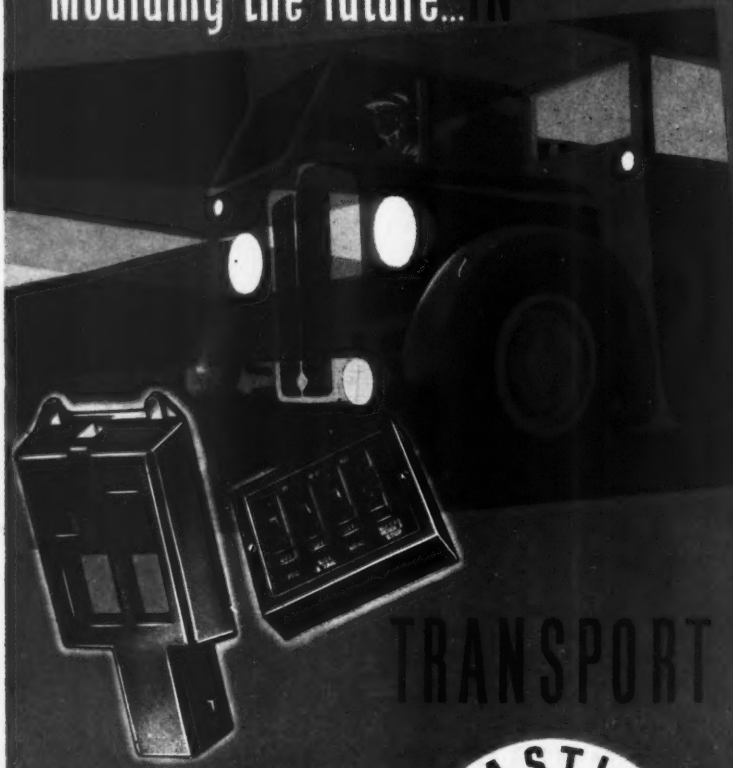
MOULDING POWDERS

The colours are stable and under normal conditions any colour can be supplied to match your individual requirements. These Celastoid Moulding Powders are remarkable for their great mechanical strength, toughness and wear resistance. If you have a Plastics problem you are invited to submit it to members of our technical advisory staff who will give you the full assistance of twenty-five years' research and experience.

a 'Celanese' Plastic

BRITISH CELANESE LIMITED ARE THE PROPRIETORS OF THE TRADE MARK 'CELANESE'

Moulding the future... IN



TRANSPORT

Mouldings for industry. Moulding Powders. Resins solid, powdered or in solution, for all classes of bonding work. Insulating varnishes. Cements and lacquers. Anti-friction resins for fabric bearings. Casting resins. Capping cements. Paint resins. Filling compounds. Sealing fluids.

PLASTICS ELO PRODUCTS

The Hallmark of Modern Plastics

Full information and data from Sales Development Department

BIRKBYS LTD., LIVERSEDGE, YORKSHIRE

PRODUCTION NEWS

Raw Materials, New Plant, Works Organization, Control Apparatus, Research, Personal and Trade Notes

THE TESTING OF PLASTIC MOULDINGS.—Some years before the war a Committee of the British Standards Institution made a comprehensive survey of the various kinds of specifications dealing with the properties of moulded insulation which the electrical engineering industry required. The needs were found to fall into three divisions:

(a) Specifications fixing the minimum requirements of moulding insulating materials for various kinds of application.

(b) Specifications of the properties of various broad classes of moulded materials.

(c) Methods of tests which could be applied to finished industrial mouldings.

Various committees of the B.S.I., the British Plastics Federation, and the Electrical Research Association, have been at work on these different branches of the work. In category "a" two specifications have already been published, namely B.S.771 (1938) and B.S.1322 (1946), dealing with phenolic moulding materials and mouldings of the phenolic and aminoplastic types respectively. In category "b," B.S.488, for materials for general electrical accessories was issued some years ago and is under revision, but further specifications of a similar kind are in preparation.

As regards tests on finished mouldings, it was realized that proof tests on complete mouldings will always be needed for the acceptance of such products. But it was considered that the development of a technique for cutting miniature test specimens from the complete moulding, and of the development of suitable tests—electrical, physical, and mechanical — on such miniature specimens was necessary as a means of effecting control over their production. The British Electrical and Allied Industries Research Association was therefore asked to investigate the problem of the development of suitable test technique.

A report was prepared by the E.R.A., and has now been published by the B.S.I. as an Interim Report on Suggested Methods of Testing Finished Mouldings, B.S.1330 (1946). It is hoped that this report will enable the electrical and plastics industries to obtain experience in the technique of the preparation of miniature test samples and of the various methods of test recommended, so that standard tests suitable for inclusion in specifications can in due course be evolved. Copies of this new British Standard may be obtained from the Publications Department, 28, Victoria Street, S.W.1, price 7s. 6d. post free.

BUSINESS TOURS IN GERMANY.—Arrangements have now been made to allow business men to visit the British and American Zones in Germany for commercial purposes. Owing to the very limited facilities in accommodation and transport, applications can only be considered from persons having a specific purchasing transaction in view. Applications should be made to Sundry Materials Branch, Board of Trade, 10, Old Jewry, E.C.2. It should be noted that imports from Germany will continue to be handled by Sundry Materials Branch.

FEDERATION OF BRITISH INDUSTRIES.—Sir Frederick Bain, deputy-president of the F.B.I., has been nominated president-elect to follow Sir Clive Baillieu, who will retire from the presidency in April. Sir Frederick Bain is a deputy-chairman of I.C.I., Ltd.

BOARD OF TRADE REGIONAL OFFICE (Wales) has removed to Imperial Buildings, Mount Stuart Square, Docks, Cardiff. Telephone: Cardiff 5920.

HYDRAULIC PRESSES up to 400 tons in size are to be manufactured by Aircraft Precision, Ltd., Croydon. These presses are intended primarily for the plastics industry, but will also meet requirements of the rubber and powder metallurgy trades. Models already in production include 40- and 60-ton electrically heated and thermostat-controlled upstroke platen presses, with built-in motors. George Cohen, Sons and Co., Ltd., have been appointed sole selling agents for these presses and such accessories as made-to-order moulds. Demonstration models of the presses may be inspected at George Cohen's works, Wood Lane, London, W.12, or at Stanningley, Leeds.

H.F. INDUCTION HEATING.—The Electronic Heating Department of Philips Lamps, Ltd., have issued a brochure of 20 pages, fully illustrated with line drawings, entitled "The A.B.C. of High Frequency Heating of Metals." Although relating to metallurgical practice, it is pointed out that there is generally urgent need for a brochure of this character, which is intended to explain the principles and applications of the high-frequency induction heating process from the practical point of view of works executives, managers and heat treatment personnel, as distinct from radio and electrical technicians. Copies of the brochure may be obtained from Philips Lamps, Ltd., Electronic Heating Department, Aboyne Works, Aboyne Road, London, S.W.17.

BRITISH COMMONWEALTH SCIENTIFIC OFFICE may be established in London as one of the main recommendations disclosed in the Report of Proceedings of the British Commonwealth Scientific Official Conference (H.M. Stationery Office, 1s. 3d.). The primary concern of this Conference was to discuss scientific collaboration, which had grown up in the Commonwealth during the war, and to devise means of ensuring its continuance and improvement.

THE GAUGE AND TOOL MAKERS' ASSOCIATION is arranging a week-end convention for its members and business friends, to be held at Bournemouth, June 6-8.

In view of the success of arrangements in 1946, when 46 members of the Association visited Paris for the International Fair, it is proposed to organize a similar visit this year to inspect exhibits of machine tools, precision tools, gauges and small tools, etc. The party will leave London on May 17, returning on May 20.

M. AND I. FOREMEN'S ASSOCIATION.—The 5th annual dinner of the Foremen's Association of The Micanite and Insulators Co., Ltd., was held at Frascati's Restaurant on January 31, and was presided over by Major Stanley M. Mohr, managing director of the company. The function was made the occasion of a presentation to Mr. W. Richardson on his retirement after 50 years' service with the company.

BOARD OF TRADE announces that as from February 6, 1947, the Token Import arrangements have been extended to Finland. Imports of goods included in the scheme will be admitted from individual manufacturers in Finland at the yearly rate of 20 per cent. by value of each manufacturer's pre-war trade with the United Kingdom in the goods in question. Applications from British importers for licences under these arrangements cannot be considered in advance of the receipt by Import Licensing Dept., 189, Regent Street, London, W.1, of the requisite Token Import Vouchers.

B.I.O.S. INFORMATION SERVICE.—The British Intelligence Objectives Sub-Committee Exhibition, which was held at the Board of Trade, Millbank, December 10 to 19, 1946, is now touring regional centres. The following dates and places have been arranged:—

Newcastle (Chronicle Hall, Westgate Road, March 17-21).

Sheffield (City Hall, March 31 to April 4).

Manchester (location not yet fixed, April 14-18).

Belfast (Technical College, May 5-9).

This Exhibition is designed to illustrate the methods by which German scientific and technical intelligence is gathered, how it is dealt with, and how the individual industrialist with his own problems to solve may avail himself of the information he requires.

PHILIPS GROUP.—By an almost unanimous vote at a mass meeting of employees at the Mitcham factory of the Philips Group of companies, where over 4,000 persons are employed, held February 17, it was agreed that these employees should work overtime, without pay, at some future date in order to make good the loss in production caused by the fuel and power crisis. This offer, the Trade Union representatives say, was made in appreciation of the action of the Philips Company in keeping all employees on the pay roll to date. On Friday, February 14, Mr. G. Leverland, plant director at the factory, spoke to employees over the loud-speaker system, when they attended to draw their week's pay. He paid a tribute to the effectiveness of the Joint Consultation system which is in operation at the factory.

Company News

J. B. BROADLEY, LTD., makers of leather-cloth and plastic-coated fabrics, have acquired the whole of the issued share capital of Texproof, Ltd., plastic sheeting manufacturers, together with the factory occupied by the latter company at Pendleton, Manchester.

DERWENT PLASTIC MOULDINGS. LTD., Bridge Works, Stamford Bridge, York, announce that they will, in future, be known as Derwent Plastics, Ltd. This change has been made for convenience, and in no way affects the present board of directors, management and staff, which remain the same as hitherto, under the chairmanship of Mr. R. W. Willsdon, who is also a director of Yorkshire Tar Distilleries, Ltd., W. and J. Glossop, Ltd., and other companies. Mr. L. R. Cornelius continues as managing director.

DOHM, LTD., have opened new works in Stoke-on-Trent for pulverizing powders for the plastic industry; this is their seventh and largest plant in the United Kingdom.

DUNBEE, LTD., have registered the trade mark "Flexatex—the flexible textile" for their printed p.v.c. material. This material is now available with a range of eight or nine designs in both one and two-colour printings. The company has now opened a larger factory at 47, Clerkenwell Close, London, E.C.1.

MANCHESTER OIL REFINERY, LTD., announce that Lt.-Gen. Sir Wilfred Gordon Lindsell has joined the board of directors. He is also a director of Petrocarbon, Ltd., and Petrochemicals, Ltd., which companies are closely associated with Manchester Oil Refinery, Ltd.

MONSANTO CHEMICALS, LTD., announce that their Manchester office, which was closed shortly after the outbreak of war, will be reopened on March 10. The office will be under the management of Mr. M. E. Meredith. The address of this new sales office will be 430, Manchester Royal Exchange (Telephone: Blackfriars 4520). As in pre-war years, Monsanto's Manchester office will service customers in Scotland, Ireland and the north of England—with the exception of those on the N.E. coast. Mr. Coleman will continue to serve the Northumberland and Durham area from the offices of Monsanto's Sunderland Works.

Dr. W. H. Garrett has been appointed director of production in connection with the company's extensive post-war development plans. For many years Dr. Garrett has been a director of Monsanto Chemicals, Ltd., and works manager at Ruabon. As a director of production, he will be responsible for the production of all plants in the U.K.

Mr. F. S. Mortimer is appointed head of the Department of Industrial and Public Relations. Announcing the formation of this new department, Mr. E. A. O'Neal, managing director, laid stress on the high degree of importance his company attaches to all phases of its relations with employees, industry and the public. Mr. Mortimer has previously been assistant general manager of Monsanto Chemicals, Ltd. He transferred his office from the Ruabon Works to the company's administrative headquarters at Victoria Station House, London, S.W.1, at the beginning of February.

Personal Notes

MR. C. L. BIRD, M.Sc., F.R.I.C., has been appointed editor of the Journal of the Society of Dyers and Colourists, in succession to the late Professor F. M. Rowe, F.R.S. He was previously assistant editor, and is lecturer in dyeing at Leeds University.

DR. R. C. G. WILLIAMS, M.I.E.E., has joined the North American Philips Co., Inc., New York, as an executive engineer, for which his wide experience in the field of radio and industrial electronics makes him eminently suitable for the post.

Forthcoming Events

March 19. I.P.I. (Southern). Polygon Hotel, Southampton. A. E. Judd (B.X. Plastics, Ltd.), "Casein Plastics at the Present Time."

March 19. Dyers and Colourists (Midlands). King's Head Hotel, Loughborough, 7 p.m. Dr. John H. Hill, "The Chemistry of Application of Detergents."

March 21. I.P.I. (Midlands). W. Wilson (General Electric Co., Ltd.), "Electronic and Light Microscopes."

March 21. I.P.I. (North-Western). Visit to Works of Breda Visada, Ltd., Littleborough, Lancs.

March 21. Dyers and Colourists (Scottish). St. Enoch Hotel, Glasgow, 7 p.m. J. R. F. Jackson, "Emulsions for Textiles."

March 25. I.P.I. (London). Waldorf Hotel. C. Wainwright, "Quality Control."

March 27. I.P.I. (Western). Prize Papers. School of Art, Brunswick Road, Gloucester. (Closing date for entries, February 28.)

April 1. I.P.I. (North-Eastern). Lecture to be arranged.

April 8. S.C.I. (Plastics Group). Royal Society of Tropical Medicine, Manson House, 26 Portland Place, London, W.1, at 2.30 p.m. A. A. Drummond and others (I.C.I., Ltd., Paints Division), "Alkyd Resins To-day."

LETTERS TO THE EDITOR

Correspondents are reminded that a stamped and addressed envelope should be enclosed in all cases where a personal answer is desired.

Apparatus for Inspecting Plastics

Sir,—We shall be obliged if you will let us know the names and addresses of manufacturers making apparatus for the inspection of small articles made from plastics, in this case artificial teeth. The test to be applied consists in shining a strong light through the body of the article to show up cracks or other faults.

COSMO DENTAL CO., LTD.
Temeside, Ludlow, Shropshire.

[EDITOR'S NOTE.—We suspect that the reader refers to a strain viewer, in which case Adam Hilger, Ltd., London, should be approached.]

Printing on Plastics

Sir,—We note with much interest and a certain amount of professional sympathy the inquiry from Thornton and Ross, in the February issue of "Plastics." Naturally we would like to point out that, in addition to the printing ink firms you recommend, we consider we are quite well-known ink manufacturers. Indeed, we have been making printing ink since 1870.

For some years past we have been experimenting with synthetic resins for printing upon plastics, and with that knowledge in mind we have taken the liberty of writing to Thornton and Ross, suggesting that we might be helpful.

In conclusion, we would like to say with what great interest "Plastics" has been read for some years past, as the materials used in your industry are often of great use in the manufacture of printing inks.

JOHNSTONE AND CUMBERS, LTD.
E. L. Cumbers, Director.
24, Sugar House Lane, E.15.

[EDITOR'S NOTE.—We regret the omission and would also like to add names like E. Marler's, of London, Ault and Wiborg and British Inks, Ltd.]

"Skins" for Hands

Sir,—Is a solution of methyl methacrylate suitable for coating surgeons' hands, as an alternative to the use of rubber gloves? Can you recommend a solution for this purpose, and indicate sources of supply?

A. E. Moss,
Superintending Pharmacist.
Royal Salop Infirmary,
Shrewsbury.

[EDITOR'S NOTE.—A solution of polymethyl methacrylate would necessarily contain an organic solvent which would be harmful with constant application on the hands. Material of any polymeric nature necessitating an organic solvent would be most unsuitable. The problem is a difficult one and we can offer no solution to it. A water emulsion of a skin-forming substance might prove suitable, but the skin might take too long to form to be of use.]

Metallized "Perspex"

Sir,—We shall be obliged if you will kindly advise us if it is at all possible to silver "Perspex" sheets for the purpose of making mirrors.

JENKINS FIDGEON, LTD.
1393, Pershore Road,
Stirchley, Birmingham, 30.

[EDITOR'S NOTE.—This idea is far from new, and since no "Perspex" mirror has yet been put on the market, presumably (indeed, we know) it is extremely difficult to silver this material.]

H.F. Heating

Sir,—I have read with interest the letter from your correspondent Mr. Stanley, published in the February issue of your journal, and having studied the figures given, I am not unduly surprised that he experienced uneven heating. In the early stages of the development work carried out by my company's research staff,

similar trouble was experienced. Now we have learned the reason and have successfully overcome the difficulty.

I am sure that Mr. Stanley will appreciate that I cannot disclose publicly the arguments which have led up to the solution of the problem, as my company do not yet wish our competitors to have access to this information. However, if your correspondent cares to contact me privately, with his assurance that he has no connection with any firm engaged upon the manufacture of radio-frequency heating apparatus, I shall be glad to discuss this matter with him in greater detail.

D. WARBURTON BROWN,
Delapena and Son, Ltd.
Cheltenham.

Plastic Leathers

Sir,—We have read with great interest the article "Plastic Leathers," in your February issue, and should be much obliged to you if you would let us have the address of Etablissements Coria, Paris, to enable us to contact them directly.

Thanking you for your kind assistance in this matter, we remain, dear sir,

FELBO AND CO., LTD.
119 Regent Street,
London, W.1.

[EDITOR'S NOTE.—We regret that we have not the exact Paris address of Etablissements Coria in our files. We hope to obtain it eventually, but suggest that the name of the town would be sufficient to reach the company. Many other inquirers have asked the same question.]

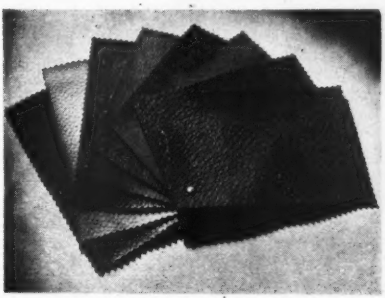
Plastic Leathers

Sir,—We have read with interest the article in the February issue of "Plastics," relating to plastic leathers, and take it that the samples shown in the photograph are p.v.c. in film form, and not supported by a cotton backing. We have been manufacturing for 12 months a similar product, which we market under the name of "Everflex," but which is p.v.c. on a cotton backing, and is produced in a variety of grains and finishes.

We consider our product has great advantage over the cast patterns described, because it can be made in any width up to 60 ins., and, being in lengths of at least 25 yds., is more economical when cutting up, either for manufacture of bags or for upholstery of furniture, motorcars, etc.

"Everflex" is only produced in colours that we can guarantee fast to light, and patterns have been tested in our laboratory and will withstand continuous flexing for 140 hrs. at 160 flex per minute.

The major portion of our output is



now being used for upholstery of cars by one of the leading car-manufacturing firms in this country.

We enclose a few patterns which we trust will prove of interest.

K. O. BERRY, Technical Director.
Bernard Wardle and Co., Ltd.
Whitehall Works,
Chinley, Staffs.

[EDITOR'S NOTE.—The samples are excellent and we congratulate this firm, both on the manufacture which makes an untearable "leather" and on the beautifully embossed designs. Regarding the French samples we reproduced in our February, 1947, issue, we must report that, with the advent of the cold weather, they have become rather stiff, although their strength remains unimpaired. The reader is in error, however, regarding the raw material used in the French type. It is not p.v.c., for it is based on a phenolic resin in part, possibly phenol-furfural.]

New Productions from the Moulding Shops

An Unorthodox Pattern in Beakers

The Streetly Manufacturing Co., Ltd., have been making moulded beakers for many years, but in common with other moulders all their beakers hitherto have been more or less of an orthodox pattern. In the new "Beetleware" beaker, which we illustrate, they certainly strike a new note as regards design, for the slightly barrel-shaped style is pleasing (might we also say appro-

priate), and it should prove comfortable to handle. Apart from being stoutly made, the barrel-shape has its own particular advantage, for it is less likely to suffer breakage upon impact, compared with a straight-sided beaker of the orthodox pattern. Four sizes are in production, ranging from half a pint to a "tot."

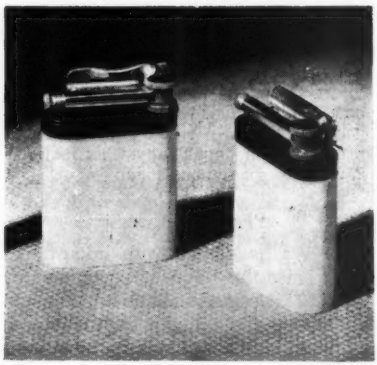
An Intricate Moulding

The "Chloroscope," which we illustrate, is moulded in a general-purpose phenolic material by United Ebonite and Lorival, Ltd., for the Paterson Engineering Co., Ltd., who are makers of water-treatment plant. Altogether seven tools are used in the manufacture. In the box and lid moulding, there are small inserts moulded in to accommodate 14 screws and two spring catches. Provision is made for carrying 14 slides (if required), each slide having a window of coloured glass. The whole assembly is extremely rigid, and weighs approximately 2 lb. The instrument is used for routine tests in the examination of water, but our object in including it on this page is to show an

intricate example among the many industrial uses for phenolic mouldings.

Refinement for a Petrol Lighter

The bodies of these "Pastel-lite" lighters are moulded in ureaformaldehyde (Beetle X) and have an attractive translucent green colour with a white mottled effect. This particular grade of Beetle moulding powder is notable for giving the most delicate shades of translucent colour. The black cap, upon which the striker mechanism is mounted, is of phenolic resin. The moulding was done by the Streetly Manufacturing Co., Ltd., for Beney (1938), Ltd., of Croydon Road, Beckenham. This lighter is exceptionally



neat in appearance, and its attractive colouring is said to be making a special appeal to the feminine user; incidentally, the mechanism is of a pattern which has been well proved in service.

Leaves from a Moulder's Notebook

This is the fourth in a series of notes by the B.I.P. Development Department on the problems of the moulder and designer. B.I.P. will send a copy of previous notes on request and will welcome comments and enquiries.

Transfer Moulding—2

Shrinkage and Distortion

The claim is often made that transfer moulding permits closer tolerances and less distortion than can be achieved by compression moulding. This claim is broadly true, yet in many cases greater distortion and shrinkage have been experienced during the teething period of a transfer mould than would be expected from almost any compression mould.

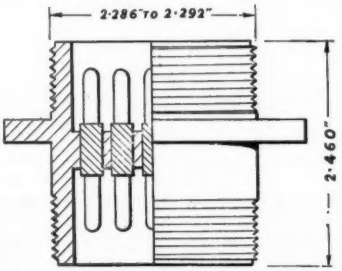


Fig. 1. Half-section of electrical moulding with 25 inserts. Transfer moulded for J. A. Crabtree & Co. Ltd., by the Streetly Manufacturing Co. Ltd.

Distortion can easily be caused by unbalanced feeding. For example, a long or tubular moulding in which the feed enters at the side will tend to bow concave at that side. It is often good practice to feed into the thick portion of a moulding; where the moulding varies in cross-section and form, any tendency to distortion will not be due to feed position if this rule is borne in mind.

Excessive shrinkage may be caused by high injection pressure coupled with restrictions on the flow of material due to small feed and gate size or uneven surface finish. In particular, as this may cause escape between the mould faces, there may be non-adherence to dimensions across the parting line of the mould or even "short" mouldings.

Fig. 1 shows a moulding which, when first produced, was smaller than required by the amounts shown in Fig. 2. The remedy lay in increasing the size of the main feed by 50% and of the gate by almost 300%.

Uniform Density

Provided care is taken to ensure correct pressure and balanced feeding, transfer moulding allows the production of parts with greater uniformity in their density than can usually be obtained by compression moulding.

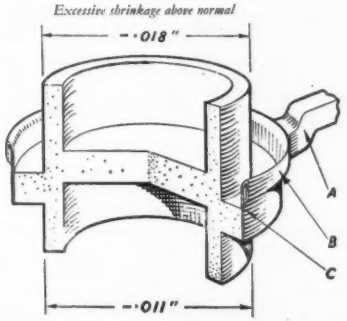


Fig. 2. Pictorial view in section (without inserts) showing excessive shrinkage above normal, which was overcome by increasing the size of feed and gates. "A" Main feed increased from $\frac{5}{32}$" to $\frac{5}{16}$". "B" Ring feed, not altered. "C" Ring gate, increased in width from .010" to .028".

The next leaf from the notebook will discuss heat control in transfer moulding.

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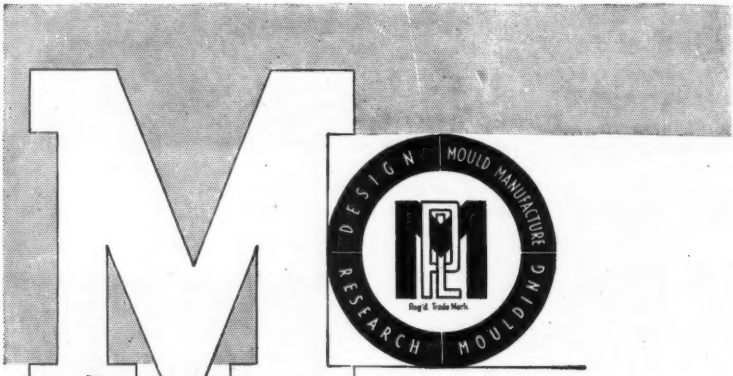

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PATENT REVIEW

The following abstracts have been made from specifications at the Patent Office, with the permission of the Controller of H.M. Stationery Office. Complete specifications can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1/- each.

B.P. 582,719. Application date: 20.10.43. Convention date (U.S.A.): 20.10.42. Accepted: 26.11.46.

Improvements in or relating to Polymerization Catalyst. To: E. I. Du Pont de Nemours and Co.

Catalysts for polymerization and copolymerization of acrylic acid or derivatives thereof in the presence of an N-chlorinated hydantoin.

B.P. 522,721. Application date: 8.12.43. Accepted: 26.11.46.

Improvements in or relating to Vinylidene Chloride Compositions. J. J. P. Staudinger, D. Faulkner and G. T. Wright. To: The Distillers Co., Ltd.

Improvements in compositions consisting of vinylidene chloride polymers or copolymers with stabilizers and plasticizers (organic esters of endo-methylene-tetrahydrophthalic acid) in proportions from 5-20 per cent.

B.P. 582,807. Application date: 1.5.44. Accepted: 28.11.46.

Improvements in or relating to Synthetic Resin Moulding Compositions and Articles made therefrom. S. A. Ede. To: James Ferguson and Sons, Ltd.

Thermosetting moulding powder consisting of rapid thermosetting phenol formaldehyde or urea formaldehyde and a fibre-forming polyamide (nylon) mixed in proportions of 2:3.

B.P. 582,853. Application dates: 21.4.44, 15.5.44, 20.6.45. Accepted: 29.11.46.

Improvements in or relating to the Manufacture of Synthetic Resins. E. Hene.

Manufacture of synthetic resins by reacting formaldehyde, thio urea, urea dicyan diamide, dicyan diamidine and thio-dicyan diamidine or mixture thereof with hydrocarbons which are liquid but not polymerizable, by heating under agitation, preferably in the form of a dispersion in water or another suitable reaction medium.

B.P. 582,887. Application date: 30.10.42. Convention date (U.S.A.): 6.9.41. Accepted: 2.12.46.

Improvements in or relating to the Copolymerization of Iso-olefins and Diolefins. Standard Oil Development Co. See also: B.P. 565,974.

Copolymerization of isobutylene in the presence of a Friedel-Crafts catalyst with a conjugated diolefin (1, 2-dimethyl butadiene-1, 3; 1, 3-dimethyl butadiene-1, 3; 1, 1-dimethyl butadiene-1, 3; hexadiene-1, 3; and 2-ethyl butadiene-1, 3).

B.P. 582,890. Application date: 15.11.43. Convention date (U.S.A.): 16.11.42. Accepted: 2.12.46.

Dialkyl Peroxides as Polymerization Catalysts. To: Imperial Chemical Industries, Ltd.

B.P. 582,899. Application date: 19.5.44. Accepted: 2.12.46.

Improvements in the production of Coloured Synthetic Resin Compositions. J. W. Coates, J. W. C. Crawford. To: Imperial Chemical Industries, Ltd.

Polymerizing monomeric methyl methacrylate and/or styrene containing a dissolved coloured chelated compound of chromium, iron, or cobalt and acetyl acetone or benzoyl acetone. Articles so produced may be used for decorative purposes, for coloured filters, lenses, fog screens, navigation lights, etc. The colours obtained are very stable.

B.P. 582,900. Application date: 19.5.44. Accepted: 2.12.46.

Improvements in the production of Coloured Synthetic Resin Compositions. J. W. Coates, J. W. C. Crawford. To: Imperial Chemical Industries, Ltd.

Similar to B.P. 582,899, but containing a dissolved coloured chelated copper compound.

B.P. 582,986. Application date: 9.12.43. Accepted: 4.12.46.

Method for the Preparation of Resin Emulsions. Communicated by: The Hercules Powder Co.

Production of stable resin emulsions by partialiy neutralizing a petroleum-hydrocarbon insoluble pinewood resin and a lower melting point pinewood resin mixture with ammonia to form a homogeneous paste. The latter is subsequently diluted with water in the presence of casein (as protective colloid), whereby free resin is formed. Alternatively, the two resins may be melted together, cooled to 110-115 degrees C. and added to an

ammonia solution containing a protective colloid, under stirring.

B.P. 583,007. Application date: 21.8.44. Accepted: 4.12.46.

Improvements in or relating to Thioplast-containing Compositions suitable for use for Sealing or Adhesive Purposes. L. E. Puddefoot, W. H. Swire and A. Bramley. To: B.B. Chemical Co., Ltd.

B.P. 583,014. Application date: 4.10.44. Accepted: 4.12.46.

Modification of the Properties of Filaments, Bristles, Yarns, Fabrics, Films and like Shaped Articles derived from B Nylon. J. R. Lewis. To: Imperial Chemical Industries, Ltd.

Modification of nylon articles substantially oriented by drawing in the presence of an alcohol (methyl alcohol) and formaldehyde in vapour form. An acidic catalyst is employed. Alternatively, nylon articles are impregnated with an acidic catalyst and subsequently heated whilst exposed to alcohol and formaldehyde vapours.

B.P. 583,047. Application date: 15.3.44. Accepted: 5.12.46.

Improved Process and Apparatus for the Polymerization of Olefines. Communicated by: The Standard Oil Development Co.

Low-temperature polymerization of a mixture containing an isoolefin and a diolefin, in the presence of a Friedel-Crafts' catalyst. A filler or pigment (carbon black, clay, zinc oxide) is added to the mixture before polymerization and a slurry containing unreacted olefin mixture, polymer and part of the filler is withdrawn during the reaction; the polymer is drained off and the unreacted olefin mixture returned to the reaction vessel.

B.P. 583,091. Application date: 31.12.43. Accepted: 9.12.46.

Improvements in or relating to the Manufacture of Spectacle Lenses from Plastic Materials such as polymerized Methyl Methacrylate or Polystyrene. A. W. Kingston and J. Johnson.

B.P. 583,118. Application date: 8.12.43. Convention date (U.S.A.): 22.5.42. Accepted: 10.12.46.

Production of High-Molecular Weight Organic Compounds containing Sulphonic Groups. To: Imperial Chemical Industries, Ltd.

Production of alkane-sulphonic acids by telomerization of ethylene or propylene by reacting them with an aqueous solution of sodium bisulphite at elevated temperatures and pressures between 700 and 1,000 atmospheres.

B.P. 583,148. Application date: 10.10.44. Accepted: 10.12.46.

Improvements relating to adhesionally Bonding by Synthetic Resin. L. Whitby. To: High Duty Alloys, Ltd.

Bonding of aluminium-alloy surfaces by interposing between such surfaces polyvinyl acetate and/or polyvinyl acetal mixed with a polyhydric phenol and para-formaldehyde, hexamethylene, tetramine, etc., in such proportions that an infusible and insoluble polyhydric phenol formaldehyde resin will form on heating.

B.P. 583,166. Application dates: 6.1.43 and 1.10.43. Accepted: 11.12.46.

Improvements in or relating to the Polymerization and Interpolymerization of Ethylene. R. G. R. Bacon and R. B. Richards. To: Imperial Chemical Industries, Ltd.

Polymerization of ethylene alone or with other polymerizable substances by reaction at elevated temperatures and high pressures in the presence of an aqueous medium, a peroxide catalyst, and a water-soluble salt of an oxy-acid of sulphur with reducing properties (e.g., sodium hydrosulphite, sodium bisulphite, sodium thiosulphate).

B.P. 583,172. Application date: 2.7.43. Convention date (U.S.A.): 4.7.42. Accepted: 11.12.46.

Manufacture of Polymers containing Oxygen. To: Imperial Chemical Industries, Ltd.

Interpolymerization of carbon monoxide with ethylene or other polymerizable compounds having ethylenic unsaturation in the presence of a peroxide compound or a derivative of orthosolicic acid at elevated temperature and pressures between 100 and 1,500 atmospheres and preferably in the presence of a non-polymerizable liquid compound.

B.P. 583,173. Application date: 2.7.43. Convention date (U.S.A.): 4.7.42. Accepted: 11.12.46.

Manufacture of Polymers containing Oxygen. To: Imperial Chemical Industries, Ltd.

Interpolymerization of formaldehyde with aliphatic olefines (i.e., ethylene) in the presence of peroxide catalysts.

B.P. 583,174. Application date: 6.8.43. Convention date (U.S.A.): 6.8.42. Accepted: 11.12.46.

Process for the Production of New and Improved Resinous Products. To: E. I. Du Pont de Nemours and Co.

Polymers formed by heating carbon

monoxide with compounds having ethylenic unsaturation, according to B.P. 583,172, are heated with an aldehyde alone or in conjunction with a phenol, urea or an amine. The resins so obtained are thermosetting.

B.P. 583,178. Application date: 3.11.43. Accepted: 11.12.46.

Improvements in or relating to the Polymerization and Interpolymerization of Ethylene. J. S. A. Forsyth. To: Imperial Chemical Industries, Ltd.

Polymerization or interpolymerization of ethylene in the presence of an ether (0.05-0.2 per cent. of diethyl ether) and up to 500 parts per million by volume of oxygen or a substance which produces oxygen.

B.P. 583,181. Application date: 31.12.43. Convention date (U.S.A.): 1.1.43. Accepted: 11.12.46.

Improvements in or relating to the Manufacture of Polymerization Products of Ethylene. To E. I. Du Pont de Nemours and Co.

Telomers suitable as substitutes for carnauba wax and other natural hard waxes produced by subjecting ethylene and dioxolane, or a saturated ketone, aldehyde, an ether (diethyl ether), an ester (acetic acid ester or methyl propionate) to very high pressures and elevated temperatures in the presence of a catalyst (oxygen or a percompound).

B.P. 583,225. Application date: 20.10.43. Convention date (U.S.A.): 21.10.42. Accepted: 12.12.46.

Process for the Polymerization of six-membered Cyclic Formals. To: E. I. Du Pont de Nemours and Co., Ltd.

Polymerization of a 1:3 dioxane (i.e., 4-methyl 1, 3-dioxane) by prolonged heating at elevated temperatures.

B.P. 583,236. Application date: 11.5.44. Accepted: 12.5.46.

Improvements in and relating to Phenolic-Aldehyde Resinous Compositions. D. N. Davies and S. R. Badley. To: Cellomold, Ltd.

Adhesive phenol-aldehyde composition containing up to 20 per cent. of soya bean flour. This composition is also suitable for the production of articles by setting in moulds.

B.P. 583,268. Application date: 28.7.44. Convention date (U.S.A.): 28.7.43. Accepted: 13.12.46.

Improvements in or relating to Alkyd Resins. To: Imperial Chemical Industries, Ltd.

Fast-drying resinous products containing glycerol, phthalic anhydride, hydroacetic acid and linseed oil.

B.P. 583,290. Application date: 16.10.44. Convention date (U.S.A.): 14.10.43. Accepted: 13.12.46.

Resinous Compositions comprising Copolymers of Vinyl Chloride and a Fumaric Ester. To: E. I. Du Pont de Nemours and Co.

B.P. 583,367. Application date: 7.2.44. Accepted: 17.12.46.

Improvements in and relating to Synthetic Resinous Condensation Products. To: The British Thomson-Houston Co., Ltd.

Synthetic resin produced by heating under alkaline conditions an aldehyde (formaldehyde) and para-sulphamyl-anilino amino 1, 2, 4-triazole.

B.P. 583,410. Application date: 25.10.44. Convention date (U.S.A.): 25.10.43. Accepted: 18.12.46.

Interpolymers. To: E. I. Du Pont de Nemours and Co.

Copolymerization of chlorotrifluoroethylene and ethylene.

B.P. 583,418. Application date: 25.10.44. Convention date (U.S.A.): 25.10.43. Accepted: 18.12.46.

New and improved Process for Producing Shaped Articles from Polytetrafluoroethylene. To: E. I. Du Pont de Nemours and Co.

Production of shaped articles by subjecting polytetrafluorethylene powder to pressure in a mould and subsequent heating to a temperature between 327 degrees C. and 500 degrees C.

B.P. 583,426. Application date: 25.10.44. Convention date (U.S.A.): 15.1.44. Accepted: 18.12.46.

Improvements in Curing Butadiene Copolymers. To: United States Rubber Co.

The improvements consist in a reduction of the rate of cure of a butadiene-styrene copolymer and is effected by adding to the stock before curing small amounts of tetramethyl thiuramdisulfide.

B.P. 583,474. Application date: 26.7.43. Accepted: 19.12.46.

Improvements in or relating to the Production of Vinylidene Chloride Copolymers. J. J. P. Staudinger, D. Faulkner and G. T. Wright. To: The Distillers Co., Ltd.

Copolymerization of vinylidene chloride and esters of maleic or fumaric acid. The copolymers so obtained have increased solu-

bility and better heat stability than pure polyvinylidene chloride.

B.P. 583,482. Application date: 4.2.44. Convention date (U.S.A.): 26.10.42. Accepted: 19.12.46.

Polymeric Materials and Process for the production thereof. To: Imperial Chemical Industries, Ltd.

Refers to polymers and copolymers of tetrafluoroethylene.

B.P. 583,504. Application date: 27.9.44. Convention date (U.S.A.): 28.9.43. Accepted: 19.12.46.

Melamine. To: E. I. Du Pont de Nemours and Co.

B.P. 583,505. Application date: 28.9.44. Accepted: 19.12.46.

Improvements relating to Injection Moulding Machines. A. Boot. To: Capon, Heaton and Co., Ltd.

B.P. 583,573. Application date: 3.11.44. Accepted: 20.12.46.

Rubber-like Materials. W. Furness and D. B. Kelly. To: Imperial Chemical Industries, Ltd.

Copolymers of butadiene-1:3 (or its homologues) and 2-ethoxy-3:5-hexadiene.

B.P. 583,661. Application date : 14.11.44. Accepted: 24.12.46.

Improvements in or relating to Hot-water Bottles. W. A. Huizinga. To: P. B. Cow and Co., Ltd.

B.P. 583,670. Application date: 15.11.44. Convention date (U.S.A.): 16.11.43. Accepted: 24.12.46.

Coating Compositions. To: E. I. Du Pont de Nemours and Co.

Primer coating composition comprising a polyhydric alcohol mixed ester of a beta-furylacrylic acid and a monofunctional monocarboxylic acid (acid of a natural drying oil), red lead, drier and solvents.

B.P. 583,606. Application date: 17.11.44. Convention date (U.S.A.): 19.11.43. Accepted: 24.12.46.

Improved Compositions comprising Polyvinylfluoride. To: E. I. Du Pont de Nemours and Co.

B.P. 583,694. Application date: 17.11.44. Accepted: 24.12.46.

Improvements in or relating to a Process for Bonding Polythene to Metal Surfaces. S. G. Foord. To: Standard Telephones and Cables, Ltd.

Bonding of polythene to copper the surface of which has previously been oxidized. The polythene film is pressed against the copper whilst it is still hot.

B.P. 583,730. Application date: 23.11.44. Accepted: 30.12.46.

Improvements in and connected with the Treatment of Polyvinyl Chloride. F. G. Dodd. To: J. A. Crabtree and Co., Ltd.

Treatment of polyvinyl chloride sleeves or tubes in order to increase their extensibility. The treatment consists in immersing such tubes or sleeves in acetone (containing water); tricresyl phosphate may also be added. This treatment causes swelling of the polyvinyl chloride, and sleeves so treated can be passed over forms larger in diameter. Subsequent evaporation causes contraction of the sleeves or tubes.

B.P. 583,754. Application date: 29.11.44. Accepted: 30.12.46.

New and improved Synthetic Resins. A. Bowman and E. M. Evans. To: Imperial Chemical Industries, Ltd.

Refers to alkyd resins modified by organic silicols and in particular to modifications with phenyl silicol.

B.P. 583,804. Application date: 23.6.43. Convention date (U.S.A.): 24.6.42. Accepted: 31.12.46.

Improvements in or relating to the Polymerization or Interpolymerization of Mono-Olefins. To: E.I. Du Pont de Nemours and Co.

Polymerization of ethylene in the presence of controlled amounts of oxygen.

B.P. 583,805. Application date: 25.6.43. Convention date (U.S.A.): 25.6.42. Accepted: 31.12.46.

Improvements in or relating to the Polymerization or Interpolymerization of Mono-Olefins. To: Imperial Chemical Industries, Ltd.

Polymerization of ethylene in the presence of controlled amounts of oxygen.

B.P. 583,844. Application date: 9.11.42. Convention dates (Switzerland): 14.11.41 and 28.11.41. Accepted: 1.1.47.

Manufacture and Use of Stabilized Mixtures containing Melamine and Formaldehyde or Condensation Products thereof. To: Society of Chemical Industry in Basle.

Melamine-formaldehyde containing mixtures stabilized with pyridine, suitable for textile baths and printing pastes.

B.P. 583,850. Application date: 28.6.43. Convention date (U.S.A.): 26.6.43. Accepted: 1.1.47.

Manufacture of Polymers and Interpolymers of Ethylene. To: E.I. Du Pont de Nemours and Co.

The Microscopic Examination of Plastic Materials

VI.—Mouldings (Fillers)—(e) Fillers from Agricultural Residues

By J. H. WREDDEN, F.R.M.S.
(Chief Chemist, Igranic Electric Co., Ltd.)

The author has now dealt with the more commonly used fillers obtained from natural products in the form of wood and nut shells. These materials are normally used in considerable quantities for filling thermosetting moulding powders, but owing to there being a scarcity of the raw materials from which they are made, the supply falls short of the demand, with the result that other raw materials capable of supplying filling substances of a similar character to those obtained from wood and nut shells are being examined.

THERE are a large number of natural products capable of furnishing suitable fillers, some of which have been mentioned in earlier articles in this series, and in concluding this section on natural filling powders it is proposed to take two examples of agricultural residues for examination in the hope that the information thus obtained might suggest ways and means of alleviating the present shortage, either directly or by suggesting other venues of investigation towards the same ultimate end.

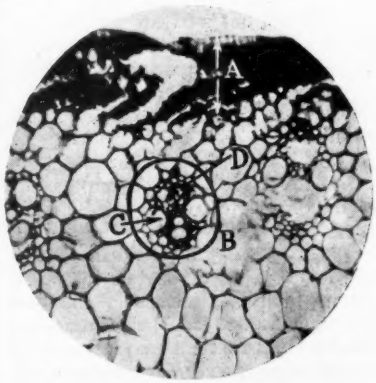

Fig. 157.—Transverse section of wheat straw. Mag. 100 diameters.

The first of these products is a powdered filler obtained from ground wheat straw or chaff, which is an agricultural residue common wherever wheat is grown.

In the first instance, the straw is the stem of the wheat plant, and as such its structure is typical of the monocot grasses. Thus the stem is hollow and relatively thin walled. This wall is composed of the thin epidermal layer beneath which is the xylem tissue embedded in the pith parenchyma. A portion of a transverse section of wheat straw is shown in Fig. 157, magnification 100 diameters, and from this we can obtain a general idea of the structure of this stem. Between the limits at A we see the thin epidermal layer, which is almost entirely composed of thin-walled cells of cellulosic nature. This layer functions as a protection against the ingress of excessive moisture and other influences detrimental to the inner structure of the stem. The latter is seen to be composed of the usual vascular bundles, each of which is surrounded by the soft pithy parenchyma, and which is typical of the monocot plants. At B we see one of these bundles consisting of the large lignified vessels C, which are usually spirally thickened; the darker mass D is the phloem or bast fibre. It will be seen that the entire bundle is encased in a layer of small cells which serve to keep the vascular bundle within bounds. The large thin-walled cells in which the bundle is

embedded form the pith in the stem, such as it is, for the thickness of this entire structure from the outer surface of the epidermis to the inner peripheral layer of the pith is barely one thirty-second of an inch.

Thus it will be seen that in the wheat stem there is only a small amount of material available, due to its thin-walled tubular structure. The structure of the stem also shows it contains a smaller percentage of useful material than we encountered in the structure, for the only components carrying appreciable quantities of lignin are the vessels to be found in the vascular bundles, and of these the most useful are the best tracheids; the large vessels being thickened in the form of an open spiral do not afford the utility of the bast element with its even thickening. The other elements of the structure depend upon the cellulose wall for strength, and whereas cellulose, as such, is a strong material, the availability of this strength depends largely on the morphological characteristics of the elements concerned. Thus in the case of the pith parenchyma, the shape of the cell tends towards the spherical, and the cellulosic walls being very thin, only a few microns would break down into small flakes and finally fine dust, so that the strength inherent in the cellulose cannot be utilized to advantage, owing to its not being available in a suitable form.

On the other hand, the cells of the epidermis are long and narrow in shape and also, as their function is primarily protective, the cell walls are considerably thicker, therefore the effect of grinding operations produce a flour element which is capable of using the strength of the cellulose wall to better advantage.

If, for the sake of argument, we look upon the utility of the vascular bundle as being unity, that of the epidermal layer will be approximately 0.5, then a planimetric analysis of the section shows the structure to be composed of about 20 per cent. vascular bundles, 20 per cent. epidermic, and 60 per cent. pith parenchyma. So that in wheat straw we have a material containing some 40 per cent. available material of an average utility of 0.75. This in itself is meaningless, so suppose we compare it with wood, which may be regarded as being composed of bark (phloem) with a utility of about 0.5 and wood (xylem) with a utility of 1. In the case of wood, however, the bark is not used in the manufacture of wood flour, therefore the average utility is also unity. In the same way, the percentage of lignified tissue is about 95 per cent. with 5 per cent. parenchyma (except in certain cases of pithy plants, which, however, are not used for the manufacture of wood flour). Thus, wood contains approximately 95 per cent. available material with an average utility of 1.

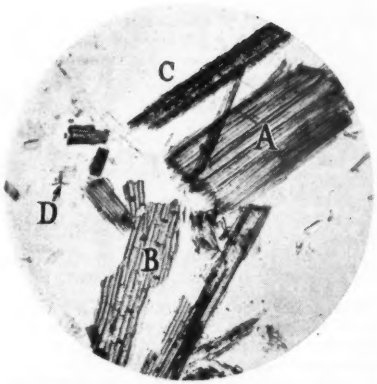

Fig. 158.—Large particles of ground straw. Mag. 34 diameters.

Nevertheless, straw powder should not be ignored as a filler on the principle that even this is better than no filler at all.

Ground straw or chaff produces a powder of very mixed characteristics, for apart from large variations in particle size, there are also similar variations in particle morphology. In Fig. 158 we see some of the larger particles of this flour at a magnification of 34 diameters, and even among these the shape is seen to be considerably varied; for example, the particle A is much different from those marked B and C, but the general shape

gives some idea of the manner in which the straw breaks down, inasmuch as the material exhibits a strong tendency to produce particles of a "flaky" nature rather than spherical or cubical. This is in all probability due to the great strength of the wheat stem in longitudinal tension, which characteristic exists by virtue of the fibrous texture of the vascular bundles on the one hand, and the longitudinal orientation of the lengthy epidermal cells on the other. It may, therefore, be considered logical to assume that the majority of the particles of this flour are derived from either one of the two useful members of the stem structure, as the pith parenchyma would be produced in the form of fine dust or very small flakes capable of relatively easy separation.

The different origins of the particles under consideration may be seen in Fig. 158. Thus, A and B are clearly derived from the epidermal tissue, the structure of B being typical; the cells are seen to be considerably longer than their width, while the whole layer is only a few microns thick. The manner in which the serrated cell boundaries fit into one another is noteworthy as being, in all probability, the reason for the greater strength along the long axis of the tissue layer. On the other hand, particle C is derived from the inner vascular bundles and very likely consists of an entire bundle, although the large vessels are not in evidence, which points to the fact that it is more likely to be composed of the phloem, or bast fibre, portion of the bundle, the strength characteristics of which need no emphasis.

Although the main purpose of the illustration is to show these large flour particles, it will be noticed that there are several smaller elements in the field, together with evidence of fine-dust material, while at D is shown a portion of pith parenchyma, which consists of parts of two cells and gives some idea of the manner of breakdown of this material. At the same time, the extremely thin walls will be noticed, resulting in the general unsuitability of particles of this type for fillers. In general, we could class these large particles as being almost flake-like in shape with an L.B. ratio of 3 to 4.

These, however, are the only type to be found among the larger elements of this flour, as there are others possessing greater L.B. ratios, such as those shown in Fig. 159, which illustrates a few of this type of element from the same specimen of flour. The magnification is again 34 diameters. These flour particles will

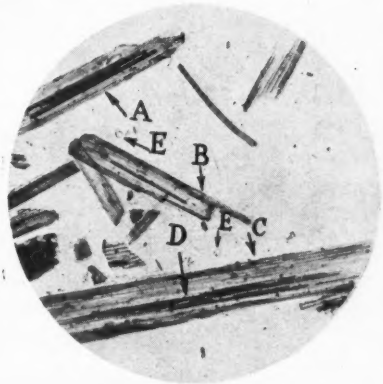

Fig. 159.—Elements of high length/breadth ratio in ground straw. Mag. 34 diameters.

be seen to be much longer than the previous in relation to their breadth; particle A has an L.B. ratio of approximately 6, while the ratio for particle B is about 4. The L.B. ratio for particle C, on the other hand, is between 16 and 18. (This is not shown in its entirety in the photomicrograph, as it was too long for the field.) From which it will be seen that although we are quite justified in classifying or grading these particles under the same heading as for those shown in Fig. 158, the morphological differences are such that the grade itself should be further sub-divided. That this is strictly necessary is realized particularly when considering the structure

of these long, thin particles, for it will be noticed that in each case there is positive evidence of long internal air spaces in the particle, as indicated by the presence of bubbles, such as that at D, from which we may conclude that the particles are derived from vascular bundles, the bubbles being the space inside the tubular vessels, while the remainder of the element is composed of bast tracheids. Thus, it would appear that this group of large particles may be easily divided into two sections, the one containing particles

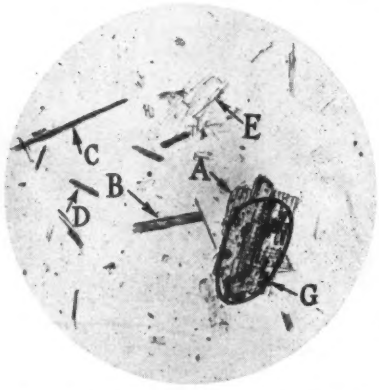

Fig. 160.—Smaller particles present in ground straw. Mag. 34 diameters.

derived from the epidermal tissue, while the other consists of particles derived from the vascular bundles. In each case, the particle is of use as a filler, being obtained from either one of the only two portions of the stem structure which are of use.

As in the previous illustration, we may again see smaller particles present, derived from both sources; also there is further evidence of the fine dust, which it should be pointed out is not entirely derived from the pith parenchyma but also from the "fines" of the epidermal and xylem tissue. This is shown by the presence of the two curious little ring structures marked E; these are portions of the spiral thickening from the large vessels of xylem tissue. As the whole wheat stem is rapid growing, and the thickening spiral in the vessel is stretched as it is laid down (in the same manner as a spring may be stretched), and owing to this stretching being so rapid, there comes a time when the spiral breaks up, leaving the thickening in the form of rings spaced some distance apart, and during the grinding process these rings become separated from the wall of the vessel and go to swell the volume of the dust or "fines" in the flour.

A somewhat similar condition exists in the group embracing the smaller particles, some of which are seen in Fig. 160, again magnification 34 diameters, showing the different types present in this group: for example, at A we have a particle which is more or less composite in structure, in as much as it appears to consist of a portion of the epidermal tissue in its characteristic flake form; but still attached to it and underneath lies a part of the vascular bundle which is immediately beneath this portion of the epidermis of the stem. The presence of the vascular tissue is shown by the bubbles in the portion of the particle which has been ringed and marked "a." The particles B and C are apparently derived from vascular bundles also, and as such are useful elements in the flour. Their long, almost fibrous shape will be noted. Also in this group we may include the small particles such as D; a number of these will be seen in the field, and it is worth while noting the regularity of size and shape; these would all appear to be derived from xylem tissue, and it seems that they represent an optimum stage in the grinding of this material, in as much as it is possible that they are obtained after a certain period of grinding, which if continued to the same limits with the larger particles will produce elements of a similar character. Thus, by systematic separation and careful control of grinding conditions, it might be possible to produce a straw flour consisting almost entirely of elements such as those marked D.

A large, thin flake of pith tissue is seen at E, which is probably in the course of

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being broken down into "fines." It will be seen that the amount of wall material present is very small, which factor, taken with the fact that the majority of this 60 per cent. of pith will be present in the initial stages as very fine dust, justifies its being classed as extraneous matter and therefore undesirable. The curious fact about this straw powder, however, is that it contains very much less than the expected 60 per cent. of dust; but this can be accounted for by screening, as the mesh size of the dust is in the region of 200 to 250, and the flour was stated to be 80 mesh, which presumably means 100 per cent. through 80 mesh and 100 per cent. retained on 100 mesh; thus the dust will be almost entirely separated in the early stages of grinding.

The miscellaneous nature of this dust is well shown by Fig. 161, which shows a number of variously shaped bits of the pith parenchyma, together with a number of scattered particles of the same tissue in dust form. Also in the field will be seen one of the ligneous rings from a large xylem vessel.

Thus do we see that this flour made from straw is in reality a very mixed substance, but this does not mean to say that it is useless as a filler. Its efficiency as such might be low when compared to wood flour, for example, but it is quite possible to use it as it is, with results appropriate to its structure; but in view of the foregoing remarks it would seem reasonable to suppose that a considerable improvement may be effected in its utility by modifications to the grinding methods and screening. Although this may be so, it should be borne in mind that there appears to be no sign of defibration of the particles examined in any of the groups. This might possibly be due to the method of grinding or to structural differences, both physical and molecular, inherent in the wheat stem, which make defibration extremely difficult. Therefore it would appear that even if the straw were ground so as to produce a flour having particles of the same shape and size, it would be less efficient than wood because of a lack of keying surface on the particles, more particularly as the lignification is so light when compared to wood.

The next flour obtained from an agricultural residue to come under consideration is that produced from cereal cob residue, which is obtained from the fruit of maize or Indian corn (*Zia mais*). This plant is of American origin and as such is one of the main cereal crops of the United States, the production of which is considerably greater than that of wheat. Although maize is grown elsewhere in the world, chiefly in Southern Europe and Africa, the main supply of

Fig. 161.—Showing additional variety of contents of ground straw. Mag. 100 diameters.

cob residue flour is of United States origin, and even this is small at present, due to its not being yet fully developed as a filler.

The cob is the woody portion of the fruit which carries the numerous seeds in parallel rows along its length. It is roughly conical in shape, its surface being covered with a number of depressions whose walls consist of the chaff or husk of the kernels, each of which is embedded in a depression, but as the empty cob is the material under discussion, no more need be said about the kernels.

The cob itself is composed of four main tissues which are developed one on top of the other, thus the central core is

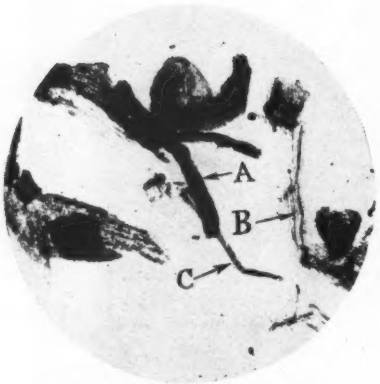

Fig. 162.—Cereal cob flour. Mag. 45 diameters.

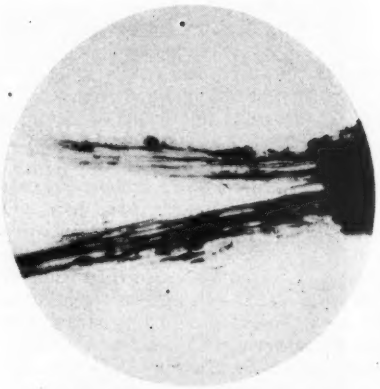

Fig. 163.—Fibrous particle in cereal cob flour. Mag. 220 diameters.

pith parenchyma, after which we have the layer of vascular bundles on top of which is what corresponds to the epidermal layer of the wheat stem, but in this case it is very much thicker, being in itself composed of two relatively thick layers, that nearest the fibro vascular layer being composed of 180 diametric cells whose walls are relatively thick and pitted, proceeding to the periphery. This layer gives way to one whose cells are possessed of similarly thickened walls, but elongated in shape. The outermost layer of cells in this case possesses a few scattered single and multi-celled hairs, and their borders are serrated to fit into one another in the same way as was shown in the epidermal layer of the wheat stem. From the foregoing it will be seen that the structure of the corn cob bears a certain similarity to that of the wheat stem, this, of course, being due chiefly to the fact that they are both monocot plants.

Thus we see that this structure of the corn cob is as mixed, so far as types of tissues are concerned, as the wheat stem; therefore we may expect the flour to be similarly mixed both in particle size and shape. As with the straw flour, this material may be divided into a number of groups; in Fig. 162 we see a photomicrograph of some cereal cob flour showing elements of a shape characteristic of one group. These are chiefly derived from vascular bundles and as such are tough and strong; three of these are shown at A, B, and C. They contain a high percentage of phloem fibres, possessing greatly thickened walls, as well as the large spirally thickened vessels, but in the case under consideration it is clear that these latter have been destroyed in the grinding, leaving a particle composed almost entirely of bast fibre, which is very desirable as a means of producing strength in a moulding.

The structure of these fibrous particles is made somewhat more clear in Fig. 163, which shows one of these particles at a magnification of 220 diameters, and from which it will be seen that the main body of the element has undergone a certain amount of difibration, amounting to splitting it into two portions, each of which displays evidence of the presence of tracheids, thus making it capable of being further sub-divided. This condition would suggest the possibility of producing a fibrous flour from this material, but it must be borne in mind that the material contains other tissues of a different character, which would effect a considerable modification of the final result.

The particles derived from the peripheral zone possess a structure similar to

that shown in Fig. 164 at A. This large particle exhibits the characteristic elongated cell structure of this zone, and, whereas the walls of the cells are not greatly lignified, they are quite thick and their shape, together with the laminated arrangement, produces a texture of considerable strength in tension, resulting in the development of a useful component in the flour. This would be of greater benefit if the grinding could be so controlled as to produce particles of more uniform shape and size. The presence of various particles derived from vascular bundles will also be noticed in the photomicrograph, and also at B there appears a particle of pith parenchyma, whilst at C the presence of a particle from the layer between the epidermal zone and the bascular bundles is indicated, and which is estimated to consist of 150 isodiametric cells and a more open structure when compared with the particle marked A.

A better idea of the structure of particle A will be obtained by reference to Fig. 165, which shows a portion of the particle in question at a magnification of 220 diameters, where the long thick-walled cells are clearly seen, as is also the manner of their arrangement. It will also be noticed that bundles of cells are seen in cross section, indicating that these lie in a direction almost at right angles to those shown in longitudinal section, and from their appearance the tubular nature of these elements may be distinguished. The curious fact about this structure is its great similarity to that of the coconut shell, which is another monocot fruit and in whose structure the tracheids or long cells were laid down in various directions, producing an interlaced structure of considerable strength. It should be remembered that, in dealing with this portion of the corn cob, we are examining that portion of the fruit which immediately invests the kernel or edible portion, and, as such, occupies the same position in relation to the corn kernel as does the coconut shell to the flesh, and bearing in mind that they are both monocot fruits, the similarity in structure is not surprising. The difference between the two materials lying in their relative thicknesses one to another, and the degree of lignification present, however, the strength to be expected from such a structure is present in this epidermal layer of the corn cob and is available in the flour particle for use as a filler.

There has been very little evidence of the presence of fine dust during the examination of this flour; this is due to the fact that the material is of relatively coarse mesh, hence the finer particles

Fig. 164.—Particles of cereal cob flour. Mag. 45 diameters.

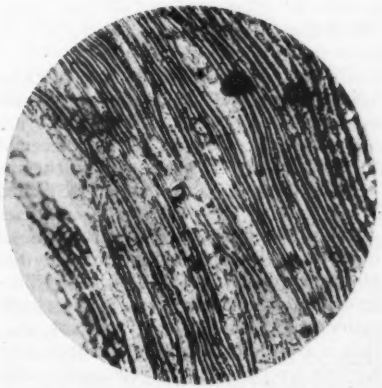

Fig. 165.—Particle of cereal cob flour showing lamellæ. Mag. 220 diameters.

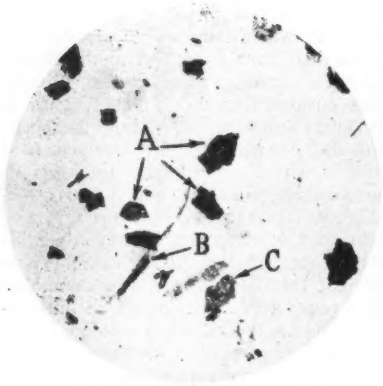

Fig. 166.—Fine dust in cereal cob flour. Mag. 45 diameters.

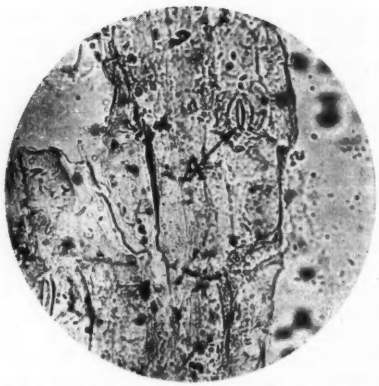

Fig. 167.—Particles of leaf epidermis of cob flour. Mag. 220 diameters.

would be almost completely eliminated in the screening operation. There does exist, however, a percentage of more or less coarse, dusty material, such as that shown in Fig. 166 at a magnification of 45 diameters. This consists of small particles from all the tissue groups, and may, in fact, be classed as a third group of particles. The particles marked A appear to be derived from the epidermal layer, and consist of small pieces of this tissue seen in plan view, as it were. Particle B, on the other hand, is obviously a portion of a vascular bundle and exhibits the fibrous nature so characteristic of this zone, whilst the particles marked C are derived from the intermediate layer.

There are also one or two particles which are scarcely distinguishable: these appear to be extraneous as they do not arise from the corn cob, but are pieces of the epidermis of the large leaf-like sheaths of the cob proper, and which are attached to the base of the cone. These particles exhibit the characteristic structure of monocot leaf epidermis, as shown by the photomicrograph in Fig. 167, which illustrates one of these particles at a magnification of 220 diameters. The whole particle is extremely thin, being composed of a single layer of the long rectangular cells which are liberally interspaced with structures such as that shown at A. These are the stomata or breathing pores and are usually found only on the surfaces of leaves and similar localities, hence the assumption that these particles have their origin in the leaf-like covering of the cob. There is no lignification in this tissue and, owing to its extreme delicacy, no mechanical strength such as that required of a filler particle. Therefore, the proportion of this material present in the flour may be regarded as extraneous and as an impurity. In the same way, the small proportion of very fine dust derived mainly from the pith parenchyma of the cob may be regarded as an impurity.

Thus we see that flour produced from cereal cob residue is capable of considerable utility as a filler, and on the result of this examination is also capable of being improved in the same way suggested for wheat and straw flour. Of the two materials, the cob residue has been tried in the United States with quite interesting results, showing promise of a useful material. In this country, however, very little work has been done on the subject as the material at hand, namely, wheat and straw, has not been available in sufficient quantity for trials on a production scale, and there seems to be some doubt as to availability in the future.

(To be continued.)

Planned Mould Maintenance Service Aids Economical Production

Section XXII (contd.)

By W. M. HALLIDAY

In the concluding instalments of this series consideration is given to the questions of tool-room facilities, methods, and equipment which can usefully be adopted to assist improved overhaul and repair activities on compression-type plastic moulds.

Some attention is devoted to the use, care, and maintenance of numerous tools and devices employed in conjunction with such moulds for facilitating operation of the moulds, and moulding production.

Ways in which the works drawing office can assist towards achieving improved maintenance service in the shape of standardised detail drawings, stock lists, component records and similar items, are also to be considered.

AS intimated at the end of the first portion of Section 22 ("Plastics," February, 1947), to bring the entire series to a conclusion it only remains to consider the subject of tool-room organization, equipment, tools and facilities, and how these may be developed or introduced so as to promote improved maintenance oversight of compression-type plastic moulds, somewhat in similar fashion to that already performed in connection with moulds employed in the injection process.

With the compression mould, too, it is necessary to employ a number of auxiliary tools, such as measuring devices, ejector appliances, extractor tools, stripping apparatus, etc., if production is to attain satisfactory and economic levels. Since the maintenance of all such equipment is important to successful moulding, it is proposed to make some mention of various useful ways by which they may be kept in efficient condition.

In addition, a brief examination will be made of the more obvious and essential points of maintenance necessary in regard to the moulding press upon which compression moulds have to be installed, since however well cared for a mould may be, if it is mounted upon a worn or inaccurate press, or improperly set-up thereon, it will fail to produce sound or accurate mouldings or maintain an efficient rate of output.

A certain number of the operating problems noted in regard to injection moulds, and the remedies suggested for overcoming same, will, of course, be equally applicable to the compression-type mould.

Thus, in respect of dowels and the need for keeping wear to a minimum, to ensure their correct alignment with guide holes in matching block, the provision of detachable, specially hardened bushings, special forms of dowel to withstand shocks and heavy loads, etc., will all apply with the same importance and facility in the case of the compression mould, because dowels play an essential part in securing alignments of mould forces and other members, as with the injection mould.

The same holds of ejector rods; insert housings; cores; and core seatings; lubrication of sliding or revolving portions of the mould; provisions against undue expansion or contraction of the mould and the consequent risks of seizure; hardening treatment; and general care in handling, storing and transporting the mould about the works.

The troubles and dangers observed in connection with each of the above-mentioned items of injection-mould construction and operation should be taken as applying also to compression moulds, most designs of which usually comprise some, if not all, of these factors, and

thereby in use give rise to very similar difficulties.

Nevertheless, because of their different principles of design, construction and operation, coupled with an entirely different set of working conditions or loads, compression moulds are subject to other forms of wear and possible breakdown. These, in turn, entail their own peculiar maintenance and repair requirements, and in consequence the need for specially suitable apparatus for the better handling and more expeditious performance of necessary repair work when the mould reaches the tool-room.

General Maintenance Activities for Compression Moulds

Before proceeding to describe the various tool-room fixtures and tools for assisting repair work, it will perhaps be profitable to recapitulate some of the chief maintenance factors to be observed in the use and care of compression-type moulds. Particularly will this be desirable, since the earlier sections of this series have largely been devoted to the study of kindred problems connected with injection kind of moulds, and very little mention has been made of those associated with the simpler forms of compression moulds, i.e., the positive, positive-flash, flash, and transfer tools.

These types of compression mould are simpler, chiefly because of their construction and method of operation. They are composed of very few members, generally two or three main forces, and perhaps one or two cores, also being usually equipped with very simple ejector mechanism, in comparison with that of injection moulds. Many such moulds are of the portable kind; that is, they are so constructed as to be almost entirely operated by hand, even being fitted to work on manually actuated presses. They have to be removed from the press platen after each compression "pull" and the forces are parted in order to remove the finished moulding, or set of mouldings in the case of the multi-impression tool. Very simple ejector gear in the form of knock-out pins is provided to assist such withdrawals of the completed moulded articles.

As will doubtless be appreciated by readers, and those having experience of the prolonged use of manually operated portable moulds, the necessary handling and moving of the tool to and from the press or unloading stand is an activity which very often results in severe wear on certain portions of the mould, wear which, in the course of time, if unchecked or uncorrected may lead to a serious seizure or complete failure of some mould member, with resultant costly withdrawal of the tool from production use.

In order to counteract such adverse effects of careless handling, and thereby to reduce the amount of maintenance supervision needed, the following almost elementary precautions should be applied systematically and with regularity.

It is customary to employ a special separate unloading table or stand in association with the press, on to which the mould can be drawn and stripped to remove the moulded part. This stand should be located as close to the press as practicable, and if it can be situated so near the press platens as to eliminate the need for a complete lift of the mould so much the better. If a gap must be left this should be as short as possible, since many portable moulds are of quite heavy weight, or bulky proportions, and an accidental drop between press and unloading station may result in serious damage to the tool, or injury to an operator.

The unloading table should also be of the correct height, that is, the same as that of the press platen when the latter is in its lower or open position. This will allow for a straightforward sliding action only when removing a tool.

Where it is inconvenient to install this unloading table near enough to the press to obviate a direct lift, some moulding engineers introduce a bridge piece of thick-sectioned steel plate, this being clipped on firmly to the edge of the press platen at one end and to the side of the

unloading tables at its other end, so as to make a rigidly secured bridge between the two members. Transfer of a mould from one member to the other then becomes merely a matter of sliding it across this bridge.

By this means such operations are not only safeguarded against personal injury of the operators and damage to a tool, but provision of auxiliary equipment of this kind serves to increase production.

It follows, of course, that some inspection will be necessary into the state of such a bridge piece, and fixture of the unloading stand. Where exceptionally heavy moulds are in operation, the great vibration set up will speedily tend to loosen the fixing of both the bridge piece and the unloading stand itself. Hence the need for regular check up of all such fastenings to ensure their correctness and sufficiency to meet the heavy demands.

The top surface of the unloading table should also be periodically checked for flatness, freedom from large or dangerous burrs, and general cleanliness. Accumulations of dirt, moulding powder, waste material, bruises, scratches, etc., not only make the passage of a mould more difficult, but will in course of time mar the surfaces of the mould forces making repeated contact with the table.

Lifting Tackle

Where a portable compression mould is so heavy or awkwardly shaped to render handling difficult, the operator should be provided with effective means for lifting the tool. All such lifting tackle, when installed, should be given the usual regular inspection from the mould maintenance engineer, and any faults should be duly noted on the repair record, especially when they have resulted in some damage to a mould.

Most manually operated portable moulds are provided with lifting handles, or rods affixed to the respective mould forces. These should first of all be conveniently placed on the mould to ensure the easiest, and most steady lift. Wrong positioning of lifting handles may give a completely unbalanced lift of the tool, imposes a risk for the operator, and usually slows down the lifting operations.

Such handles should be securely fastened to their respective force blocks, and observation taken regularly to make sure they remain secure. Loose handles, or those capable of being readily unscrewed, are dangerous, and a sure means of causing delay and trouble. When the mould is being constructed, handles for this purpose must be permanently fixed. Simply screwing them into tapped holes in the force is hardly sufficient since they can very easily be removed. Cross-pinning to prevent them being unscrewed is the safest method.

All handles of the above kind should be made long enough. Very many portable mould constructions err in this connection by having handles much too short to allow the operator to get adequate hand grip, or to prevent the handle from becoming too hot to be used with comfort and safety.

Wherever possible such handles should be insulated against the heat of the mould. Furthermore, it is advisable to make the handle of that shape which ensures the firmest hand grip. Straight cylindrical rods therefore are not the most suitable in this latter respect.

Where it can be conveniently arranged the handles should be located well away from the steam inlet valves on the mould force, in cases where the mould itself is directly heated.

On many portable compression moulds locating gibs or strips have to be provided on the press platen for the rapid positioning of the mould in its correct place. Steps are usually machined along each side of the bottom force for engaging under these locating strips. Both gibs and the steps on forces often require some attention, as the gibs tend to work loose thereby allowing wrong positioning of the tool on the platen; also they may become choked with dirt, oil wastes, etc., making admission of a mould more difficult. The steps on the mould also very often become bruised, worn, and sometimes distorted, again making for stiffened working and increased difficulty in securing proper location.

On some portable compression moulds the forces are channelled out for the circulation of steam during the compression and curing stages; for water during the ejection stage. This entails a series of valves and piping to the mould, which again require a certain amount of regular supervision for avoiding leakages, wear of valves, distortion of feed pipes and so on. Here the maintenance toolmaker when inspecting the mould proper would also give more than a passing glance at the condition of all inlet and outlet valves, pressure cocks, pipe connections, rate of flow, channel clearances, and, indeed, every possible aspect of the steam heating and water cooling apparatus.

With many types of compression mould the task of ejecting the finished component and dismantling the mould involves the positioning of the entire mould into some awkward angle. Where this is necessary care should be taken to ensure that the operator is provided with a properly designed nest into which the mould can be placed when elevated to the ejecting angle. Such a nest should, of course, not simply consist of a few pieces of wood or loose bits of iron, since such ramshackle structures carry great risks. Preferably, they should be incorporated directly into the unloading table, being made a fixture thereon, and so arranged as to be capable of withstanding a great deal of weight and forcible usage.

If space permitted, the author could give numerous examples from his own personal experience where severe damage has been inflicted on a costly tool because of the lack, or obvious inadequacy, of provisions for holding the mould in the proper position during ejection or reassembly. This may seem an elementary precaution, but practical experience and close contact with the use of such moulds over many years demonstrates that it is an aspect of moulding very often neglected, due to the fact, one supposes, that often it is nobody's special business to see that correct provisions are made. It is outside the mould designer's province, and unless the moulding-shop foreman or maintenance engineer is alive to the risks involved he, too, is apt to overlook such a need. As a result, makeshift methods are adopted at the beginning of a mould's career, and continued in use until a serious accident occurs, or some similar drastic event arises to direct attention to the unsuitability of the method.

Incidentally, such an attitude to the apparently unimportant secondary aspects of moulding procedure applies not only to the case just mentioned but to various others, where makeshift provisions are allowed to persist often to the reduction of production rates and possibly risk of mould injury.

Therefore the author makes no apology for dealing at length with such seemingly elementary and obvious features, and would urge all maintenance engineers having control of moulds to bestow a wary eye on such points when making their regular inspection of moulds. It is really surprising what improvements can be effected along these avenues, even in what are deemed to be efficiently organized moulding shops. It must be remembered that each compression mould is in effect a unique mechanical contrivance, calling for special handling consideration and provision of its own peculiar equipment or methods, which if not selected will incur diminished production, more difficult and protracted handling, and increased danger of inflicting injury to the delicate mechanism of the mould.

The same applies to the question of tools supplied to the operator for manipulating the mould. All tools for ejecting the finishing moulding, operating the ejector plugs, levering off the top force, cleaning the mould cavity, lubricating vital portions of the mould, etc., should receive the same care and regular inspection for suitability, adjustment and replacement that is usually bestowed on the mould itself. Here again the author could instance numberless cases where an otherwise excellent mould has been ruined because of an operator being allowed to use entirely unsuitable tools for performing some essential operation.

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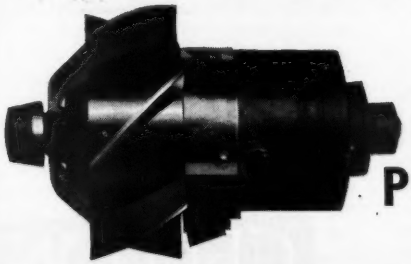

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spite of the trouble and initial expenditure involved, is to supply each press operator with a complete kit of correctly designed and constructed operating tools, properly laid out in a chest or kit. No operator should be permitted to possess and use makeshift tools of his own making for the purpose of cleaning the mould cavities, removing forces, chase rings, ejector plugs, insert housings, and all similar features of the mould.

The maintenance toolmaker should undertake a periodical check-up on all tool-kits thus provided, and where necessary make such corrections, renewals or additions as required.

When a new mould is received in the production shop for its first run, both the mould designer, shop engineer and maintenance toolmaker should be present to supervise the selection of all such tools or equipment deemed necessary for the efficient handling of the mould. Such a rule will ensure first that responsibility for intelligent consideration of this important aspect of moulding practice is fixed, and secondly that effective tools will be secured.

Compression moulds having inserts for moulding into position often require some special attention and extra care during handling, since it is usual to allow the operator to deal with the positioning of new inserts in between each "pull." Here again proper provisions are necessary if these tasks are to be performed efficiently and with safety.

Where a mould is fitted with a number of inserts of almost identical dimensions, it will be advisable to make some means whereby the operator can rapidly check the inserts before applying them to their housings. Better still, if the mould design can be so adapted as to make this operation fool-proof, so much the better. Tools are sometimes needed for placing inserts into position. Care must be taken to ensure that such tools, whilst being suitable for holding and positioning the insert, are not injurious to some other portion of the mould. Many a mould cavity surface has been irretrievably damaged by an insert-holding tool of wrong design or shape. On this aspect of moulding practice, therefore, the mould maintenance engineer will have to assure himself that possible sources of danger do not exist.

Of course, each type of portable compression mould will, to a large extent, present its own set of handling as well as operating difficulties, therefore it is not possible here to do other than lay down certain general rules of mechanical soundness which will be applicable to all forms of such moulds. The objective, in short, should be to ensure accuracy and long life by seeing that it is not subjected to very severe stresses or clashing during the transfer from press to table and vice versa, or that risks are not taken by the mould being too heavy for the operator to lift unaided by crane or davit.

Maintenance Attention Distinct from Mould Handling

All the foregoing points are concerned chiefly with the care and maintenance supervision needed to safeguard the handling operations of portable compression moulds.

Some mention will now be made of the general features of maintenance services involved with compression moulds.

Taking first the positive type of mould, in which the top force is telescoped into the bottom force in order to obtain the full pressure of the press ram on to the material, the needs should be few and of simple nature.

The top force should be maintained a close fit within the bore of the bottom force, otherwise loss of pressure and leakage of plastic material will ensue. Provisions should be made in the original construction for the bottom force to be bushed with special hard liners capable of being easily renewed when worn. If possible, those forms of construction should be selected which provide for dowels to align the top force in addition to its fit within the bore of the bottom force. Such a provision will permit much longer life and the maintenance of original accuracy.

The chase or bolster ring should also

be amply proportioned to withstand, first, the moulding pressures, heat and stresses attendant upon actual moulding, and, secondly, the strains of usage during loading and unloading operations. This member will have to be carefully and regularly checked for burrs, scratches, etc., likely to cause stiffened assembly, or defects in the finished moulding, since, in many forms of positive mould, the chase provides a portion of the cavity area.

Top and bottom register plates whereby the tool is located for assembly, as well as on the press platen, must also be of robust strength, well fixed to their respective force members, and again regularly inspected for security of fixture, freedom from burrs, and dirt accumulations, and absence of distortion. These latter features may cause a serious misalignment of the whole mould when placed on the press, and a drastic and harmful unbalance of the ram pressure.

Some attention will also be required to questions of lubrication. Very often on compression moulds, especially the simple form of positive moulds, lubrication of the few moving parts becomes a difficult problem, since oil has to be prevented from passing into the cavity area. Providing the forces, etc., have been correctly hardened and well polished, and are kept scrupulously clean before each reassembly, the need for lubrication can be kept very low. Small amounts of dry lubricant will be found the most suitable medium for these circumstances.

In the case of flash and positive-flash type moulds, an additional maintenance requirement exists. These moulds provide for a definite flash formation on the finished moulding, and for this purpose they possess flash lands or ridges. As is well known, such lands at certain stages of the moulding cycle have to bear the full pressure of the ram. For this reason they are subject to wear and require special attention from the maintenance engineer.

After prolonged use of the mould these lands may sink a slight amount, or become unevenly worn because of the highly abrasive action of the plastic material which has to flow over the land surfaces at each cycle of operations.

The maintenance engineer, therefore, will have to pay special attention to these portions of the mould, and it is advisable to undertake correction of even slight amounts of land wear. The lands' surfaces also must be maintained in a highly polished state since rough surfaces at this point would merely add to the frictional resistance of the passing plastic material and set up greater wear.

Care should also be taken by the maintenance toolmaker to ensure that the width of such land portion of a mould is not unduly increased as a result of repeated repolishing and correction. Rarely is it advisable to have lands wider than $\frac{5}{16}$ in. Repeated grinding however may easily cause the land to be made much wider. Proper width will have to be restored by machining material off the slant side of the land ridge.

In the case of the positive-flash type compression moulds the design is actually a combination of the positive and flash types, in that flash formation is allowed, but means is provided for cutting off the flash at a certain stage so as to allow for the full pressure of the ram to be exerted upon the material. This entails the provision of land area around the mould cavity, and behind them there extends a well portion into which the flash can flow immediately before cut-off.

In servicing such moulds considerable care will have to be taken when restoring the polish or evenness of the land, to prevent making too great a reduction in the well area. Some makers provide lands and wells on one force only, thereby securing some economy in original machining. It also facilitates repair work, since the danger of over widening the lands or making the wells too shallow is confined only to one force instead of both as normally occurs.

Split-type Compression Moulds

With this type of compression mould usually a considerable degree of maintenance supervision and attention is required.

The split mould is employed when the finished article has to have side corings, holes, undercuts, or recesses. These are formed by interposing split pads between the top and bottom forces instead of having the one directly telescoping into the other. Such splits are carefully assembled prior to each pull, and then when the mould is dismantled they can be pulled apart sideways, leaving the finished moulding, complete with cored side holes.

Supervision Details

First, very great care must be observed when making and fitting such splits originally in the new mould, and all intersection surfaces between splits and the chase ring, or bottom force, must be extremely close fitting.

Secondly, very accurate measures must be provided for ensuring the correct location of the split pads. Usually they are fitted into a tapered hole in the bottom force, or chase, as the case may be. A useful safeguard is to make them headed at the top and by means of which ample dowel pins can be employed for the more reliable location of the splits.

Thirdly, considerable wear attaches to such splits, since at each withdrawal from the press the mould has to be completely dismantled and the splits forced apart in order to remove the finished moulding. Such usage generally causes burrs, bruises, distortion, and cracking of split pads. Hence the maintenance engineer will have to pay particular attention to the condition of such mould members. If they are allowed to continue in service in a distorted condition an inaccurate moulding may result, or increased difficulties encountered when ejecting.

Fourthly, because of the increased number of mould parts in the split type construction, together with a correspondingly increased number of mould joints and intersection points, unless care is taken undesirable flash may be formed on the moulding. To keep this down to a minimum is another reason why especial care and observation should be devoted to such moulds.

Very often when split pads become worn, or distorted, it is extremely difficult for the maintenance toolmaker to correct them without involving serious departures from initial accuracy of the tool. In such circumstances it is often the most economical plan to equip the tool with new splits. Since this contingency is likely to arise frequently, the author would recommend that whereever possible the seating shape and dimensions for housing splits in a mould should be kept standard, so that spare split pads may be machined up on external surfaces to fit those seatings, the only requirement being to machine their internal portions to the requisite shape to suit the mould needing replacement splits. This practice will often be the means of saving very considerable amounts of time.

Knock-out Facilities

Provision should also be made for proper knock-out facilities for such splits. Reliance should never be laid upon pinch bars, lever, or screwdrivers, etc., for forcing apart splits. Disposition of the knock-out holes should be well removed from cavity forming surfaces of the splits, or from thin edges liable to be snipped.

Very often inserts are used in conjunction with split pads in a mould, and these deserve careful inspection from time to time by the maintenance engineer. The author has found from experience that several apparently minor troubles are associated with this insert feature in the following manner:—

Inserts are, of course, positioned in the split pad members of the mould before its reassembly, and therefore an operator is easily able to locate the insert part. Should an oversize insert accidentally find its way to the loading table it has been known for an operator to force such a part into an insert housing, thereby causing damage to the seating and surface of hole. Again, because of the easy access afforded by this type of mould construction an insert housing may receive damage from an operator using an entirely unsuitable tool for cleaning out dirt, etc.

It requires to be strictly stressed upon

all press operators that in the case of difficulty in locating an insert piece, or in clearing a seating of accumulations, the greatest care must be exercised in the choice of tool selected for the task, and the manner in which it is used. The best safeguard is for the inspecting mould maintenance toolmaker to make a careful check on their condition at each visit he makes to the mould for the purpose of detecting developing faults, etc.

These various points by no means exhaust the number and variety of operating faults, snags and features which the observant maintenance engineer will strive to obviate or reduce, but space forbids any further consideration being devoted to such interesting points, in order that some attention may be given to the equally important subject of tool-room accessories, fixtures, etc., which have been found helpful in promoting better, quicker and less expensive repairs.

(To be continued.)

A NEW CONSTRUCTION FOR FURNITURE

(Continued from page 128.)

"Reduxed" to the flat surface of the angles; the veneered metal panel was then glued cold to these strips with Aerolite 300 and colourless hardener G.B.P.

In order to make drawers run silently (where provided in other pieces of the suite) a thin layer of felt was glued to the runners, using Aerolite 300 and hardener G.U.

The dressing table consists of a single sheet of veneered metal mounted on cast aluminium legs, with a small cupboard on the right-hand side. In order to avoid screw or rivet heads on the table, the top surfaces of the cast base were veneered and cold glued to the underside. Similar attachments for the mirror had a "Reduxed" aluminium supporting frame. The upper surface of the stool is also free from screw heads.

Regarding the bed, both the head and foot frames are of aluminium extrusions with panels of olive ash veneers on 18 s.w.g. light alloy sheet.

These examples suffice to show the way in which Mr. Latimer has made use of Redux bonded material to produce a range of furniture designs to meet modern needs.

BIBLIOGRAPHY

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HALOGENATED POLYTHENES

(Continued from page 142.)

operation with its attendant long stoving, all the other treatments being brief in themselves and in the associated bakings.

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Volatile spirit (3 hrs. at 110°C.) %	46·5
Total solids %	53·5
	100·0%
Viscosity (centipoises) at 25°C.	460
Specific gravity at 25°C.	0·942
Filler Material	
Volatile spirit (3 hrs. at 110°C.) %	32·5
Total solids %	67·5
	100·0
Viscosity (centipoises) at 25°C.	1600
Specific gravity at 25°C.	1·450
Sealing Varnish	
Volatile spirit (3 hrs. at 110°C.) %	30·0
Total solids (Chloro poly ethylene base)	70·0
	100·0
Viscosity (centipoises) at 25°C.	920
Specific gravity at 25°C.	0·930

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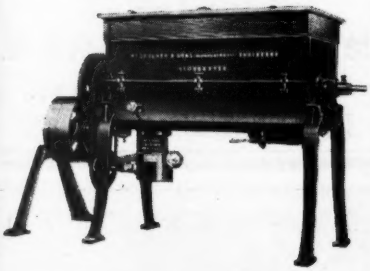

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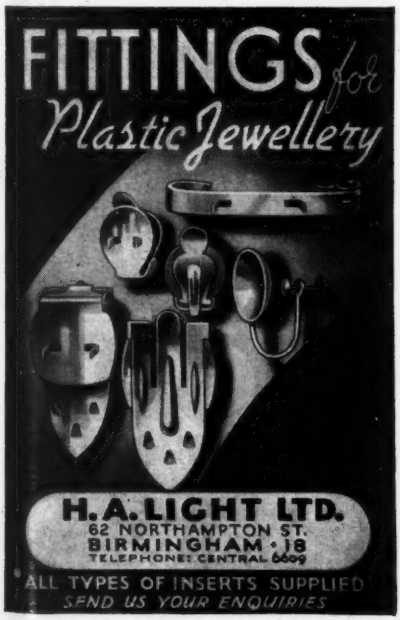

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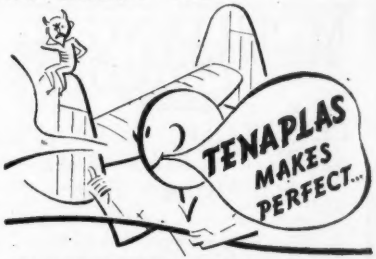

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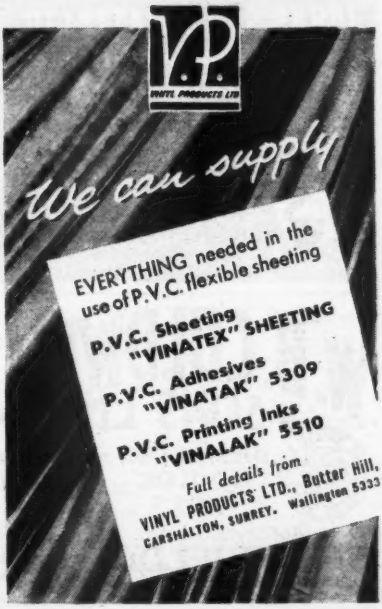
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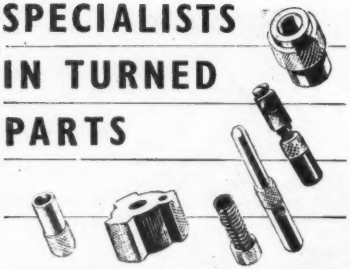

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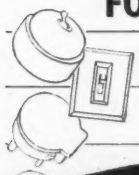

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AUCTIONEERS, VALUERS AND SURVEYORS
of
INDUSTRIAL PROPERTY, PLANT AND MACHINERY,
GRANVILLE HOUSE, ARUNDEL STREET, LONDON, W.C.2.
Phone, Temple Bar 7471 (four lines).
zzz-408

DRAWING OFFICE EQUIPMENT

Uno Pen Stencils for quick and perfect lettering of plans and tracings. West and Partners, 36 Broadway, Westminster. 120-7071

HOBBED MOULDS—WANTED

Rubber manufacturer wishes to place large order for multiple cavity hobbed steel moulds for heels. Willesden Rubber Co., Ltd., School Road, London, N.W.10. 118-30

MACHINERY, TOOLS AND PLANT

New hand hydraulic pumps, ⅝-in. plungers, 2-ton pressure, release valve, tank base, £15 each. Thompson and Son (Millwall), Ltd., Cuba Street, Millwall, London, E.14. 119-8460

IMMEDIATE DELIVERY EX STOCK AT LOW PRICES.

4 ft. 6 ins. double roll edge runner mill, £120

25 cast-iron Government surplus erecting benches, 9 ft. by 2 ft., fitted six C.I. legs, £15 each only.

Stainless filter vessel, 1 ft. 6 ins. diameter, 1 ft. 6 ins. deep, £35.

Kestner 200 lb. w.p. air heater, 20 ft. by 3 ft. 2 ins., £400.

Two air receivers, welded 19 ft. by 4 ft. 2 ins., 150 lb., £150 each.

Three G.W.B. electric furnaces, circular Government units, 5 ft. 8 ins. o.d. 8 ft. 4 ins. o.len, with recorders, etc., £500 each (cost £1,000).

14 welded retorts, 1 ft. 9 ins. by 1 ft. 6 ins. by 8 ft. 3 ins., £60 each.

25 tons const. channels, 12 ins. by 3 ins., £14 ton.

Steele-Shaw A.C. motor-driven paint agitator, £150.

3 1½-in. rotary lacquer or varnish pumps, £30 each.

Two A.C.-driven three-throw vertical tam varnish pumps, £100 each.

Four new Canning treble-cased ovens, 6 ft. by 6 ft. by 6 ft., £140 each.

Three new asbestos electric ovens, 6 ft. by 3½ ft. by 5 ft., £85 each.

Trolley jacketed dryer, 30 ft. long, 8 ft. 6 ins. diam., £375.

Vertical two-bowl rubber calender, solid rolls, 24 ins. by 13 ins., £300.

Spiked roll pre-breaker (prev. used asbestos), £200

Complete chromating plant by Canning.

Complete Parkerizing plant.

Selection only from stock. Send your inquiries.

HODSON AND CO. (MACHINERY), LTD.,
TOTTINGTON, BURY, LANCS.
Phone, Tottington 123-4.
119-9547

For sale, one Duncan Stewart tableting machine, at present fitted with punches and dies to make tablets 1 in. diameter, producing approximately 80 per minute with two dies. Complete with 5 h.p. motor, starter and one spare set of punches and dies. Box 6903, care of "Plastics." 118-22

For immediate delivery.
Several sets of high-speed pumps by Towler Bros., 200 cubic ins. per minute, 1½ tons per sq. in., complete with valve gear, tank and motor, A.C. voltage. Box 6811, care of "Plastics." 118-11

SPECIAL OFFER—HYDRAULIC PLANT.

10-cwt. hydraulic accumulator by Tangye, tank-type, 6 ft. 0 in. diam., 6 ft. 0 in. deep, with three-throw pumps, £250.

Two hydraulic intensifiers by Vickers-Armstrongs (Government surplus), 45 tons w.p. with

Two Vickers motor-driven horizontal hydraulic pumps, direct coupled units, with red. gear, 5 tons w.p., £750 each complete unit.

Immediate delivery ex stock. Really low prices.

HODSON AND CO. (MACHINERY), LTD.,
TOTTINGTON, NR. BURY.
Phone, Tottington 123-4.
119-9546

Shipton injection moulding machine, suitable for Alkathene up to 20 ozs., together with moulding powder, brand new. Apply Box 7016, care of "Plastics." 118-7

Machinery, Tools and Plant Wanted

Wanted, injection moulding machine, 2 ozs. capacity approximately. Full details, price, and where can be inspected, to Box 6904, care of "Plastics." 118-21

PRODUCTION CAPACITY AVAILABLE AND WANTED

Pulverizing and grading of raw materials. Dohm, Ltd., 167 Victoria Street, London, S.W.1. zzz-369

WELL-KNOWN FIRM
with
EXTENSIVE HOME AND EXPORT SALES ORGANIZATION
invites offers of
ENTIRE OUTPUT ON PROMPT CASH BASIS
BY MANUFACTURERS OF
MECHANICAL METAL AND PLASTIC TOYS AND NOVELTIES.
Apply, Box 2405, care of "Plastics." zzz-383

Repetition in Ebonite, Erinoid, etc. Capstan lathe work. Mansell, Temple Street, Rugby. 125-8451

London firm requires for home and export market plastics, household goods, including beakers, cups, saucers, plates, spoons, etc., in urea or phenol formaldehyde. Box 1427, care of "Plastics." 118-8062

Work wanted, tool room available for all sorts of press tools. Press work, assembling, spraying and all sorts of engineering to your design. Universal Components, Ltd., 19 Sunderland Terrace, W.2. Bay 6776. 119-7900

S. R. F. FREED, LTD.,
THE STOCKISTS OF SHEETS, RODS, TUBES, OFFCUTS AND SCRAP,
OFFER OTHER LINES WHICH CAN BE USED IN COMBINATION WITH PLASTICS, UTILIZING ANIMAL AND VEGETABLE PRODUCTS,
Such as tortoiseshell, horn, cleaned and prepared cattle bones for industrial purposes, vegetable ivory nuts, porcupine quills, goose and duck feathers, and barrels, etc.
S. R. F. FREED, LTD.,
27b HIGH STREET, SOUTH NORWOOD, S.E.25.
Phones, Livingstone 4042; Sanderstead 2056.
121-402

Injection Moulding. Capacity on 10 gm., 2 oz., 3 oz., 4 oz. and 8 oz. machines available. Tools designed by ourselves or customers' own tools used. Enquiries invited for both home and export. Box 6804, care of "Plastics." 118-31

Custom Moulding. Capacity on injection up to 8 oz. and compression up to 250 tons available. Technical advice on your moulding problems gladly given. If you do not already have your moulds, our design experts are at your service. Box 6805, care of "Plastics." 118-32

Specialists in Polythene Moulding have capacity available up to 20 oz. using customers' own moulds or moulds designed by us to suit customers' requirements. Technical information given on request. Box 6806, care of "Plastics." 118-33

Plastic Side Combs available from stock, 3½ ins. long, 27s. 9d. per gross for 10 gross lots. Apply, Polytex Products, Ltd., 10 Union Court, Wormwood Street, London, E.C.2. Phone, London Wall 2298-9. 118-27

Celluloid or Plastic Balls, 2½ cm. diameter, 5-10/1,000 in. thick, required in large or small quantities from stock, or by manufacture if capacity available. P. A. Adolph, Langton Green, Tunbridge Wells, Kent. 118-1

Off-cuts or Supplies 1/32-in. celluloid needed. Box 6901, care of "Plastics." 118-24

Plastic Photo Frames. Offers wanted from firms able to manufacture above and similar lines for the export and home markets. Box 6902, care of "Plastics." 118-23

Tufnol Polished, sheets, 48 ins. by 48 ins., thicknesses ⅛ in. and 3/16 in., for sale. Box 6813, care of "Plastics." 118-19

J. H. Berry (Plastics), Stockist, offer clear and coloured perspex in standard and non-standard sheets or cut to requirements. J. H. Berry (Plastics), Portland Works, Annesley Woodhouse, Notts. 118-18

Export Only—Plastic Braces. Manufacturer wishes to contact persons interested in good-class braces, B.O.T. licensed. Also ladies' and gent's plastic belts, etc. Manor Products, 80a Rear Neville Road, Forest Gate, E.7. Phone, Gra 4150. 118-16

Design. We would gladly collaborate with your own staff on product and tool design. Hart-Still and Associates, Industrial Designers, 880 Green Lane, London, N.21. Laburnum 6121. 118-35

Production Capacity Available and Wanted (contd.)

Wanted, a large quantity of cellulose acetate sheet or rolls, 10-1000 in. thick; water clear, matt or embossed pastel shades. Offers to Franco-British Electrical Co., Ltd., Colindale Avenue, Hendon, N.W.9. Colindale 6581. 118-10

We are able to undertake certain small runs of plastic moulded products and individual plastic moulded products. Use our services for the preparation of prototypes in plastics. All inquiries strictly confidential. Cottrell and Co. (Plastic Section), 15-17 Charlotte Street, London, W.1. zzz-394

Wanted, large quantities of plastic toothbrush handles, samples and quotations invited. Please contact Cawnpore Industries, Ltd., Cawnpore, India, by airmail. 118-x6657

Sales organization are desirous of contacting actual manufacturers who wish to find a market, both home and export, for their products. New good lines, whole production taken. Box 5988, care of "Plastics." 118-x6542

Quantity of plastic moulds, compression and injection, in new condition, for sale. Box 6155, care of "Plastics." 118-x7095

Cartons.
We are large stockists of new and once-used cartons. Once-used cartons in corrugated and fibre-board are carefully sorted and are in every respect equal to new. We would welcome your inquiries. List upon application.
Export cases.
We are able to make any quantity of export case. Delivery within 14 days of receipt of order. A sample case is dispatched before purchase, for test and inspection. For the home market we can make cases to your specification from seasoned converted timber without licence.
Wooden boxes measuring 21c by 12½ by 8 always in stock at 2s. 3d. each delivered London or F.O.R. Full tea chests 4s. 6d. each; half chests 3s. 6d. All clean and sound, coopered on uncoopered.
We can supply gummed tape up to three inches width, and can incorporate the trade mark of your company for a charge of 1s. per coil extra.
Large stocks of paper always in stock, and your inquiries are welcomed.
Our packing service can accept your goods, pack them, see to documents and place on board ship.
If your problem is packing, consult the specialists.
W. Page and Sons, 34 Langside Crescent, Southgate, London, N.14. Phone, Palmers Green 5087.
Redundant cartons, in first-class condition, purchased for cash. zzz-398

Mould-making, injection and compression, and moulding capacity immediately available. Box 6195, care of "Plastics." 118-9074

1½-2-oz. Injection Moulding Capacity required; own mould supplied. Box 6667, care of "Plastics." 119-9355

For sale, finely ground material, suitable for the plastics industry; large quantities available. The Oilcakes and Oilseeds Trading Co., Ltd., 108a Cannon Street, London, E.C.4. 119-9357

High-frequency sealing capacity available for P.V.C., etc. Sealing, welding of all kinds. Send inquiries to Industrial Research Corporation, 4 Pembroke Walk, London, W.8. 119-x8534

Urea powder wanted in large or small quantities; offers. Box 6671, care of "Plastics." 119-9354

Perspex Off-cuts, clear and coloured, cut to required size, lactoid rods and all forms of scrap plastic material; immediate delivery. Write, Plastic Department, J. E. Hoare, Byton Chambers, Amen Corner, S.W.17. zzz-399

Wanted, plastic waste and plastic piece goods. Send particulars, stating quantity and price. Box 6695, care of "Plastics." zzz-400

Perspex sheets or offcuts required, in clear or colours, any thickness up to ⅜ in. Universal Brush Co., Ltd., Luton, Beds. zzz-407

Cellulose acetate scrap urgently required, best prices paid. Write Cuprex, Ltd., Adelphi Terrace House, Robert Street, Strand, W.C.2. Phone, Tem 0902. 129-406

Perspex. We are stockists of I.C.I. Perspex. Try us for your requirements of clear and coloured sheets. Cuprex, Ltd., 1-3 Robert Street, Strand, W.C.2. Temple Bar 0902. zzz-405

Acetates, Bakelite, Perspex products. Stamped in gold, silver, colours. Trade. The Superb Stamping Co., 84 Highbury Park, London, N.5. Canonbury 1915. 118-x9437

Urgently required, black acetate sheet .080 in., transparent ruby .030 in. Particulars to Central Engineers, Ltd., 120 Old Street, E.C.1. Phone, Cle 2586. 120-9544

Production Capacity Available and Wanted (contd.)

P.V.C. plastic sheetings, 18 ins. by 20 ins. by 2 mm., in various colours and embossed patterns. Supply ex stock. Also ⅝-in. beltings. J. Shepperton and Co., Ltd., 161 Drummond St., W.1. 120-9543

Engraved name plates, scales, dials, etc., supplied. Tickets and Co., Box 2, Silver Street, Leicester. 129-9541

Wanted, injection moulding capacity. Substantial continuous order for long period. Weight of article 33 grains each. Commodities Trust, Ltd., 12-13 Henrietta Street, London, W.C.2. 118-4

Perspex for sale, 240 sq. ft., brand new, clear, flat ⅛-in. sheet, £75 the lot. Box 6921, care of "Plastics." 118-x9195

Fancy Jewellery Manufacturer wishes to contact injection moulder able to undertake designing and production in quantities for home and export trade. R. K. Slessor and Co., 33 Victoria Street, Blackburn, Lancs. Blackburn 49395. 118-x9172

Capacity for injection moulding up to 1½ ozs. material in colour range for export only. Short runs considered. Write Box 6895, care of "Plastics." 118-x9160

SITUATIONS VACANT

Shorthand Typists, Private Secretaries, Clerks, etc. If you are in urgent need of staff, contact Embassy Secretarial Employment Bureau, Excel House, Whitcomb Street, W.C.2. Whitehall 5924. We specialize in efficient personnel. 124-8069

Albright and Wilson, Ltd., invite applications for their Technical Sales Staff in the South Eastern area and Yorkshire in connection with development of the uses of Dow Corning Silicone products. Applicants should preferably hold a science degree or its equivalent and be between the ages of 23 and 33. Details of experience and qualifications should be sent to 49 Park Lane, London, W.1. 118-9356

Chemist (Qualified) for research on plastics required by well-known manufacturers near London. Experience in organic and physical chemistry preferred, but not essential. Permanent and progressive positions, with good salary and excellent prospects. State particulars of education, past experience, age and salary required. Strictest confidence assured. Box 7018, care of "Plastics." 119-9542

Imperial Chemical Industries, Ltd., Plastics Division, Welwyn Garden City, wish to augment their technical staff concerned with the development of plastics in many new industries.
Applicants, who may be chemists, physicists or engineers, must have good scientific qualifications, and additional research or industrial experience is highly desirable.
A knowledge of one of the following subjects would be an asset:—Rubber or Plastics Technology, particularly moulding and extrusion, Rubber Latex, Film-forming Materials, the Application of Polymers to Textiles, Cable and Electrical Technology.
Some of the posts are concerned with detailed investigational work, others with techno-commercial development.
Age preferably under 35.
Apply in writing for application form to the Staff Manager, I.C.I., Ltd., Plastics Division, Welwyn Garden City, Herts. 118-29

Contact Representative required by manufacturers of plastic advertising signs and displays for the London and Home Counties area. Applications will be considered only from those well versed in the needs of this particular industry. Salary, expenses and commission basis. Write, with full details, to Box 6906, care of "Plastics." 118-28

Plastics Technician or Scientist capable of directing research and development required for the utilization of thermoplastic scrap. Only applicants with practical experience and high qualifications, in particular with practical knowledge of American methods, need apply. Company wishing to engage applicant intends to reorganize and extend its plastics department, and successful applicant would have substantial income, good prospects and permanent position. Box 6898, care of "Plastics." 118-26

A Responsible Executive Appointment, involving considerable travel abroad, is to be made by manufacturers of plastics machinery, and applications are invited from men, over 30, with the following essential qualifications:—Wide engineering experience (preferably of plastics machinery), sound knowledge of export procedure, experience of foreign travel and languages. Applications will be considered only when accompanied by full details of qualifications and experience. Write, Box 6900, care of "Plastics." 118-25

Situations Vacant (contd.)

Foreman for Perspex.
First-class man wanted, must be able to jig and tool-up articles for blowing and machining. Able to organize labour. Box 6809, care of "Plastics." 118-13

Head Foreman Required to take charge of injection moulding shop. Must be fully conversant with operation of semi-automatic machines and maintenance of same. Capable of organizing production and finishing section. Highest integrity necessary. Good salary and prospects for right man. Apply, Box 7017, care of "Plastics." 118-8

Sales Representatives, both travelling and resident, are required for territories in Great Britain by established manufacturer introducing a new range of plastics machinery. Experience in selling machinery essential. Applications will be considered only when accompanied by full details of past experience. Box 7015, care of "Plastics." 118-6

Plastic Mouldings. Prominent company requires a man, aged 30 to 35, with first-class knowledge of mould design and production, together with practical moulding experience on modern equipment. To an educated, energetic and capable man, the post would give opportunity to develop as moulding production engineer to plant in the London area. Write, with full particulars of qualifications, experience and salary (in confidence), to Box M1461, A.K. Advg., 212a Shaftesbury Avenue, W.C.2. 118-5

Jig and Toolmaker, used to Perspex, wanted for small factory. Excellent prospects for keen man. State salary required and previous experience to Box 697, care of Pool's, Aldwych House, London, W.C.2. 118-2

Plastics. Experienced man required by West London factory to operate modern Daniells moulding press. Should have practical experience of both transfer and injection type moulds on similar type of press. Good wages and working conditions. Superannuation fund. Five-day week. Apply, Box 6951, care of "Plastics." 118-x9287

Required, Makers-up of sponge bags and other articles from plastic sheeting. Reply, with particulars of experience, if any, to Box 6810, care of "Plastics." 11812

SITUATIONS WANTED

Capable young production engineer, experienced in plastic moulding, tools, jigs and design, studying for certificates, keen, energetic. Position now held, assistant manager with plastics manufacturers. Efficient and good organizer. Seeking advancement. London area. Box 6896, care of "Plastics." 118-x9164

Works manager desires post. Long experience in compression and injection moulding, complete charge of plant, tool design, estimates, costing, control of labour. Box 6953, care of "Plastics." 118-x9765

Laminated Plastics. Insulation engineer. A.I.E.E., M.Inst.B.E., 16 years' experience plant, materials, processes, testing and research, seeks progressive, responsible post. Available August. Present post technical manager. Box 6984, care of "Plastics." 120-x9154

Foreman, fully experienced in compression and injection, seeks situation. Box 6924, care of "Plastics." 118-x9217

Thermo-plastic Expert, eight years foreman, machining, moulding, designing, tooling, requires position, foreman or manager, Perspex fabrication. Box 6922, care of "Plastics." 118-x9201

Expert in thermosetting and th. pl. mat. mould and jig designer for compr. inj. extruding, blowing, fabricating, seeks position in London area. Box 6783, care of "Plastics." 118-x8951

Specialist in manufacturing of all kinds of buttons for home trade and export, designer with ideas seeks position in London area. Box 6784, care of "Plastics." 118-x8951

Young energetic works manager requires position, experienced all methods of production, control of labour, London preferred, but not essential. Box 6860, care of "Plastics." 118-x9153

TIME RECORDERS

Factory time recorders. Service rental. Phone, Vigilant 4731. Time Recorder Supply and Maintenance Co., 157-159 Borough High Street, S.E.1. 125-8459

WANTED

Scrap. Why not let a well-established firm quote you for cellulose acetate, Perspex, P.V.C. cuttings and other thermo-plastic off-cuts and scrap? Having best use for these materials, highest prices can be paid. Quotations on receipt of representative samples to M. H. Grist (Plastics), Ltd., 82-84 Brighton Road, Surbiton, Surrey. Phone, Elmbridge 4214. zzz-395

Acetate (cellulose) sheeting.
Wanted to purchase for cash, any quantity, colour or thickness. Send particulars with samples.
Ailans, 37 Farringdon Street, London, E.C.4. 119-9352

Wanted (contd.)

Acetate sheet and offcuts urgently required in white and pastel shades, up to 8s. 6d. per lb. paid for clean material. Also injection moulding powders urgently wanted, injection moulding scrap and sprew. Powder price paid. Studio Mfg. Co., 169-171 Brearley Street, Birmingham, 19. 119-8314

Scrap plastic material wanted, any quantity. Perspex, Lactoid, Catalin, Acetate, Bakelite, Presspahn. Write, Plastics Dept., J. E. Hoare, Byton Chambers, Amen Corner, Tooting, S.W.17. 124-404

Cellulose sheets or offcuts in 20-60/000 in. thick, in transparent or opaque, urgently required for manufacturing purposes. Box 6899, care of "Plastics." 120-9545

Perspex sheet and offcuts wanted, clear and coloured, all thicknesses. Box 6812, care of "Plastics." 118-17

Wanted, Perspex sheet or offcuts to blank, 3-in. circles, 1/24 in. thick. Ruby or deep amber. Polished both sides. State price and quantity offered. Box 6952, care of "Plastics." 118-x9287

Brush makers require quantity of tooth brush and nail brush backs in plastics. Write, Box 3814, Williams's Advertisement Offices, Bradford. 118-x9057

Bakelite or similar, to process 1¾ in. by ¾ in. by ⅛ in. thick. 13 Kew Road, Southport. 118-x9211.

MISCELLANEOUS

Extend Your Trade.
Use a Trade Mark. Consult
Trade Mark Protection Society,
12 Church Street, Liverpool. 118-6372

For sale constantly, cut-offs of ⅛ and 1/16 in. natural Holoplast, from 1s. per lb., according to size of pieces. Larks Spraying Process, Monument Hill, Weybridge. 119-x7997

Photography by Behr will show your product at its best. Ask for illustrated list. 44 Temple Fortune Lane, London, N.W.11. Speedwell 4298. 121-9072

Cellulose-acetate offcuts for sale, 20 thous. thick, polished both sides, all colours, sizes approximately 24 ins. by 5 ins. The Wearmouth Plastics Research Laboratories, 46 Laugherne Road, St. John's, Worcester. 118-x8248

Plastic boards, 1/16 in., specially treated, highest artistic finish, suitable for panelling, furniture, bath, splash-backs, etc; plain colours or marble effect, and wood (oak, mahogany, walnut, etc.), sheets 8 by 4 or cut to requirements. Prompt deliveries. Larks Spraying Process, Monument Hill, Weybridge. 119-x7998

Cartons (surplus), as new, for sale. Various sizes, cheap. Universal Components, Ltd., 19 Sunderland Terrace, London, W.2. 119-9540

For sale, Avery counting scales, will weigh up to 5 lb.; 10-1 and 100-1. Box 6803, care of "Plastics." 118-15

For sale, 2 to 3 cwt. black acetate moulding powder. What offers? Box 6807, care of "Plastics." 118-14

Monomarks. Permanent London address. Letters redirected, 5s. p.a. Write, Monomarks, BCM/MONO76, W.C.1. 122-9353

Ebonite and bakelite always in stock. Phone, Archway 3654. A. E. Goodeve, Ltd., 188a Seven Sisters Road, London, N.7. 121-9075

For sale, the following goods in Perspex at sacrificial prices: 2 dozen cake stands (large), 1 dozen cake stands (small), 3 dozen jam dishes. The lot for £55 or in £5 lots. White, 57 Gartlea Road, Airdrie, Lanarkshire. 118-x8718

Wire lamp-shade frames. Best quality spot welded. Large and small users consult us with your special designs, or send for particulars of our standard designs. D. Potts, Newlongton, Preston, Lancs. 119-x9100

FOR RUBBER AND PLASTIC DIES OR MOULDS—AND SPECIAL MACHINES
the name is LAW
for the rapid execution of your ORDER
F. W. LAW & Son Ltd.
CASTLE WORKS,
MANCHESTER ROAD, ROCHDALE.
TELEPHONE: ROCHDALE 3002.

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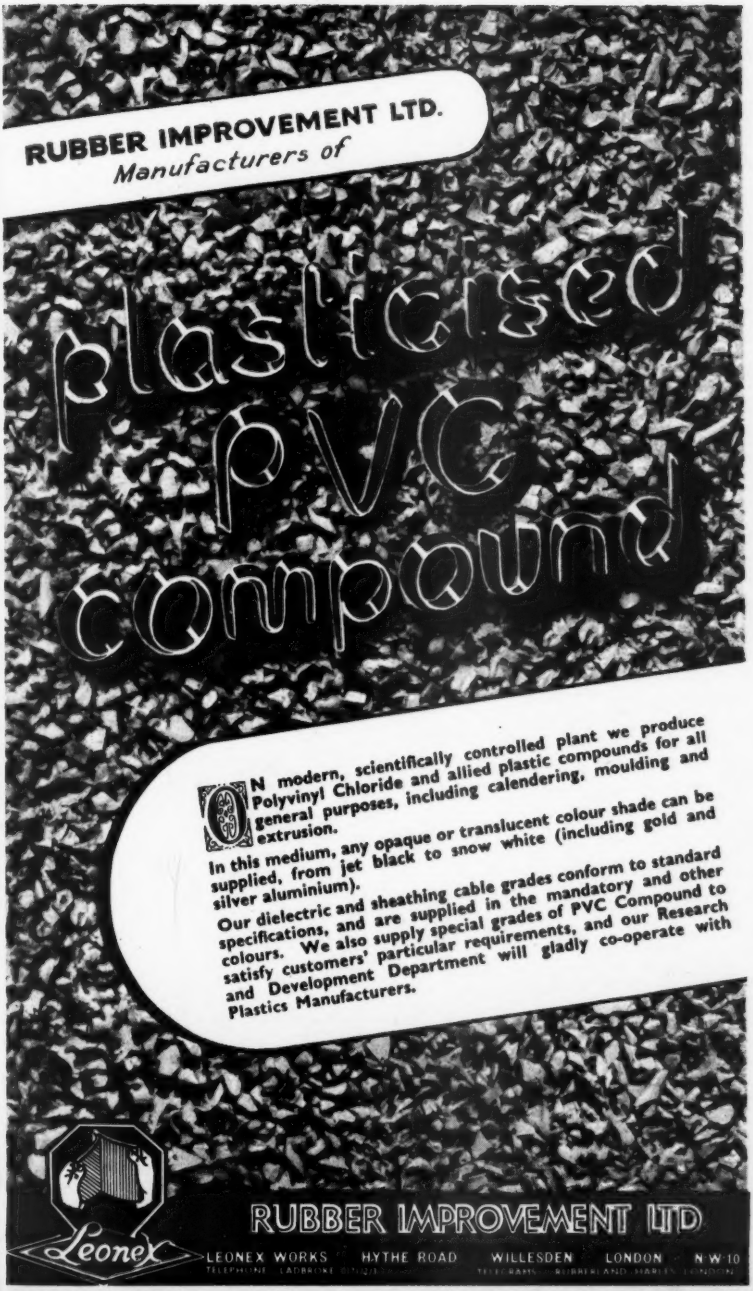
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ON modern, scientifically controlled plant we produce Polyvinyl Chloride and allied plastic compounds for all general purposes, including calendering, moulding and extrusion.
In this medium, any opaque or translucent colour shade can be supplied, from jet black to snow white (including gold and silver aluminium).
Our dielectric and sheathing cable grades conform to standard specifications, and are supplied in the mandatory and other colours. We also supply special grades of PVC Compound to satisfy customers' particular requirements, and our Research and Development Department will gladly co-operate with Plastics Manufacturers.
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NORTHERN AREA OFFICE Roya London House, 190, Deansgate, Manchester. Telephone: Manchester, Blackfriars 7880.

MARCH, 1947. Vol. XI. No. 118 **Plastics** TWO SHILLINGS

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or white or green or purple. 'Lassolastic' is the ideal self-adhesive tape for all sealing, naming and identification purposes. No tools are needed to apply 'Lassolastic'. Simply press on lightly with the fingers and it clings with a binding firmness to metal, wood, glass, plastics and any other smooth, dry material. 'Lassolastic' is resistant to water, oil and solvents. Being slightly extensible it moulds itself to hinges, seams, beadings and other irregularities. 'Lassolastic' thus forms a perfect air-tight seal for all types of food and chemical containers. It can be applied to cables and components for easy identification, or to furniture, toys and other articles as name tags.

Obtainable in a wide range of indelible colours, plain, or printed to suit your own requirements. Printing cannot be erased. Further information on request.

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Self-Adhesive Tape

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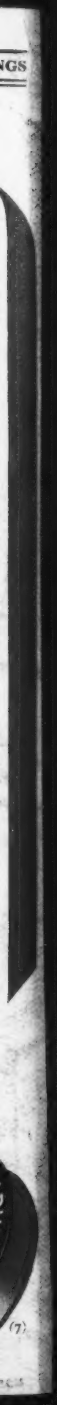
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